the glass industry
VOLUME 38, NUMBER 2, FEBRUARY, 1957

A Survey of the Effect of Composition on the Internal Friction of Glass

By L. C. HOFFMAN and W. A. WEYL
Division of Ceramic Technology,
The Pennsylvania State University, University Park, Pa.

TABLE OF CONTENTS

I. Introduction
II. Experimental procedure
III. Results
  a. Effect of annealing
  b. Alkali silicate glasses
    (1) Effect of soda content on the Sodium Peak
    (2) Effect of soda content on the whole curve
    (3) Other alkali silicates
  c. Effect of other cations
IV. Discussion
V. References

ABSTRACT

The effect of widely varying composition on the internal friction of glass was studied in order to provide a basis for an atomistic interpretation. Glass rods were caused to twist by incorporation in the vertical member of a torsion pendulum and the damping of the pendulum was observed as a function of temperature. Internal friction peaks for Li^+ and K^+ ions were observed in addition to Na^+ ion peaks as observed by others. A second internal friction peak was observed in $R_2O \cdot RO \cdot XSiO_2$ glasses at a higher temperature than the "alkali" peaks. The gradual replacement of Na^+ by K^+ or Li^+ caused the alkali peak to disappear and the intermediate temperature damping to become large. The replacement of Mg^{2+} by Ba^{2+} Cu^{2+} or Pb^{2+} had a similar "tightening" effect on the alkali at low temperatures, but yielded higher damping at high temperatures. The high temperature peaks are probably best explained by the presence of oscillating volume elements of greater size than ions—lending support to hypotheses of a discontinuous structure for glass.

I. INTRODUCTION

It is now well established that complex silicate glasses show deviations from Hooke's law which are the result of structural changes. In these glasses the elastic strain lags behind the stress. C. E. Guye and S. Vasileff[1] first observed these effects by observing the logarithmic decrement of the damping of torsional oscillations of glass rods. H. Rotger[2] and K. Bennewitz[3] suggested that it is the Na^+ ion which causes the damping. J. V. Fitzgerald, K. M. Laing and G. S. Bachman[4] made a study of the internal friction of a "plate" glass as a function of frequency and temperature and recommended the method for exploring the structure of glass. By applying the Arrhenius equation to the temperature dependence of the maxima observed in internal friction, they were able

Dr. Hoffman is now Research Chemist, Technical Section, Ceramic Division, Electrochemicals Department, E. I. du Pont de Nemours & Co., Inc., Perth Amboy, N. J.

Part of a Ph.D thesis, the Department of Ceramic Technology, The Pennsylvania State University, as a result of research work sponsored by the Office of Naval Research under Contract N6 onr 269 Task Order 8, NR 032-264, Technical Report No. 71 (reproduction in whole or in part is permitted for any purpose of the United States Government). Also Mineral Industries Contribution No. 56-22.

to further reinforce the idea that Na^+ ion diffusion causes the damping. F. Horton[5] showed that the damping of mechanical vibrations of pure silica increases steadily from room temperature to 500° without the occurrence of maxima. It seems that the introduction of alkali into the glass is responsible for the appearance of peaks.

In order to develop an atomistic picture of the processes causing the peaks, experimental data were required which covered a large field of simple glass compositions, since available work was restricted to a few complex commercial glasses.

II. EXPERIMENTAL PROCEDURE

The equipment used in the experimental work was a modification of Fitzgerald's[6]. Essentially, a torsion pendulum was surrounded by a combination furnace and cooling device and provision was made for incorporating glass rods into the vertical member of the pendulum. The oscillations of the pendulum were followed by means of a suitable mirror, light beam and photoelectric recorder.

The glasses studied were melted from c.p. chemicals in platinum crucibles except for those containing large amounts of heavy metal ions. These glasses were melted in kyanite crucibles. Rods about 1 and ½ mm. in diameter, 25 cm. long were drawn from the glasses in the manner described by J. P. Poole[7].

The internal friction was calculated from C. Zener's[8] equation:

$$Q^{-1} = \frac{2.3}{N} \times \log \frac{Ao}{An}$$

where N = total number of vibrations, Ao = amplitude

TABLE I

Molar Composition	Temp. of Ten-Minute Heat Treatment—Degrees C.	Temp. of Peak at 0.37 Cycles per Second—Degrees C.	Temperature Coefficient for Peak Cal./Mol.
Na_2O-$3SiO_2$	510	—31	20,000
		295	45,000
Li_2O-$3SiO_2$	500	—25	37,700
		230	52,200
K_2O-$3SiO_2$	525	60	15,400
		250	44,300
$0.5Na_2O$-$0.5K_2O$-$3SiO_2$	465	130	11,600
$1/3Na_2O$-$1/3K_2O$-$1/3Li_2O$-$3SiO_2$	525	350	24,300
Na_2O-MgO-$5SiO_2$	500	—6	19,900
Na_2O-MgO-$4SiO_2$	520	—4	14,000
Na_2O-MgO-$3SiO_2$	500	—18	8,800
$0.9Na_2O$-$0.2NaF$-MgO-$4SiO_2$	490	3	19,000
Na_2O-CaO-$5SiO_2$	510	53	20,600
Na_2O-SrO-$5SiO_2$	525	95	22,300
Na_2O-BaO-$5SiO_2$	560	0	13,750
Na_2O-ZnO-$5SiO_2$	525	—10	17,250
Na_2O-CoO-$5SiO_2$	510	....	.....
Na_2O-PbO-$5SiO_2$	545	....	.....
Na_2O-$0.25CuO$-$0.75MgO$-$5SiO_2$	510	38	10,750
Na_2O-$0.50CuO$-$0.50MgO$-$5SiO_2$	465	60	14,400
Na_2O-$0.75CuO$-$0.25MgO$-$5SiO_2$	435	40	52,000
Na_2O-CuO-$5SiO_2$	460	270	10,100
Na_2O-MgO-$0.4Al_2O_3$-$3.6SiO_2$	580	16	16,700
		310	116,200
Na_2O-MgO-$0.8Al_2O_3$-$3.2SiO_2$	580	13	4,740
		307	118,000
Na_2O-MgO-$0.2B_2O_3$-$3.8SiO_2$	530	—10	6,500
Na_2O-MgO-$0.4B_2O_3$-$3.6SiO_2$	540	9	21,200
Na_2O-MgO-B_2O_3-$3SiO_2$	540	28	52,400
Na_2O-MgO-$2B_2O_3$-$2SiO_2$	520	....	.....
$0.875Na_2O$-$0.125K_2O$-MgO-$4SiO_2$	520	68	24,600
$0.75Na_2O$-$0.25K_2O$-MgO-$4SiO_2$	510	215	31,600
$0.50Na_2O$-$0.50K_2O$-MgO-$4SiO_2$	520	166	20,100
$0.25Na_2O$-$0.75K_2O$-MgO-$4SiO_2$	550	179	50,800
$0.125Na_2O$-$0.875K_2O$-MgO-$4SiO_2$	530	170	12,500
K_2O-MgO-$4SiO_2$	540	—4	11,100
Na_2O-$2MgO$-Al_2O_3-$6P_2O_5$	520	258	22,500
Na_2O-$2CuO$-Al_2O_3-$6P_2O_5$	480	380	32,000
$0.5Na_2O$-$0.5K_2O$-$2MgO$-Al_2O_3-$6P_2O_5$	480	330	26,400

of the 1st vibration, An = amplitude of N^{th} vibration.

Each glass was first run in its chilled state, exactly as drawn from the melt. The glasses were annealed in place by allowing them to remain 50° above their transformation interval for about 10 minutes, cooled to room temperature and then re-run.

An arbitrary, convenient frequency of vibration, 0.37 cycles per second, was chosen for comparison; all internal friction maxima were observed at one or more other frequencies to allow calculation of temperature coefficients.

In calculating the temperature coefficient of the peaks it has been assumed to be an activation energy by other workers. In metals, it has been observed that the internal friction peaks merely shift along the 1/T axis when the frequency is changed. In the glasses studied, the peaks changed in shape and the ordinal valve of the internal friction maximum also changed. The high temperature peaks were particularly sensitive in this respect. Accordingly, the temperature coefficients are given in energetical dimensions calculated by normalizing the curves but it seems unlikely that the internal friction phenomena are all "activated processes."

III. RESULTS

The molar compositions, calculated from the batches, the temperature at which the glasses were stabilized and the temperature at which internal friction peaks occurred are listed in Table 1. The last column contains temperature coefficients calculated from the temperature shift of the peaks with changes in frequency of the pendulum.

a. Effect of Annealing

Fig. 1 is the complete internal friction temperature curve for $Na_2O MgO 5SiO_2$ glass. The upper curve determined on the glass as formed; the lower after a ten minute heat treatment at 500°C.

The effect of annealing was to lower the values of internal friction markedly without shifting the temperatures at which maxima occurred very much. Internal friction measurements are a sensitive tool for studying thermal history.

b. Alkali Silicate Glasses

(1) *Effect of Soda Content on the Sodium Ion Peak*

Figs. 2 and 3 are internal friction versus temperature curves for annealed alkali and alkali-magnesia-silica glasses. The values of observed internal friction increased and the temperature of the maximum decreased as the alkali content was lowered.

(2) *Effect of Soda Content on the Whole Temperature-Internal Friction Curve*

Increasing the soda content increased the internal friction over the whole temperature range. The curves in Fig. 4 are for heat-treated glasses and the high temperature damping (ca.300°) showed an indication of a new maximum.

(3) *Other Alkali Silicates*

Fig. 5 illustrates the characteristic sharp peak obtained in Na^+ ion containing glasses. It can also be seen that Li^+ ions gave an alkali peak only slightly lower in magnitude than the sodium ion peak and even K^+ ion containing

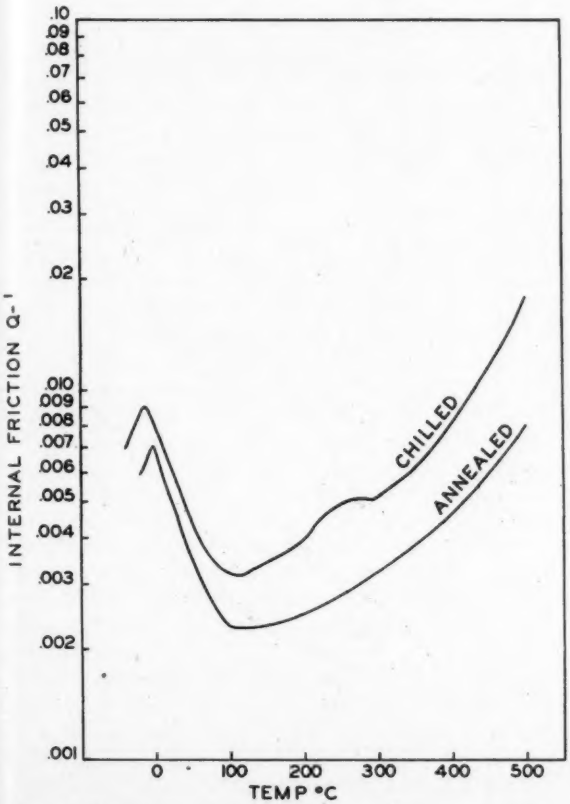


Fig. 1. Internal friction vs. temp. for chilled and annealed $Na_2O. MgO. 5SiO_2$ glass.

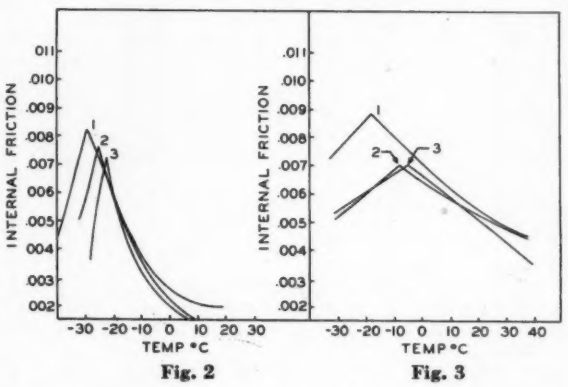


Fig. 2 Fig. 3

Fig. 2. Effect of soda content on the sodium ion peak in alkali-silicate glasses,

1—Na_2O – $3SiO_2$
2—Na_2O – $4SiO_2$
3—Na_2O – $5SiO_2$

Fig. 3. Effect of soda content on the sodium ion peak in alkali-magnesia-silicate glasses,

1—Na_2O – MgO – $3SiO_2$
2—Na_2O – MgO – $4SiO_2$
3—Na_2O – MgO – $5SiO_2$

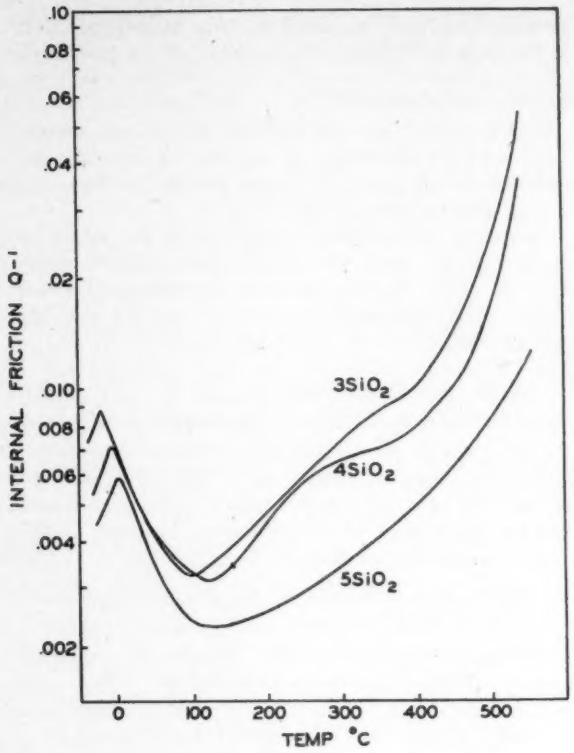


Fig. 4. Internal friction vs. temp. for Na_2O. MgO. x SiO_2 glasses.

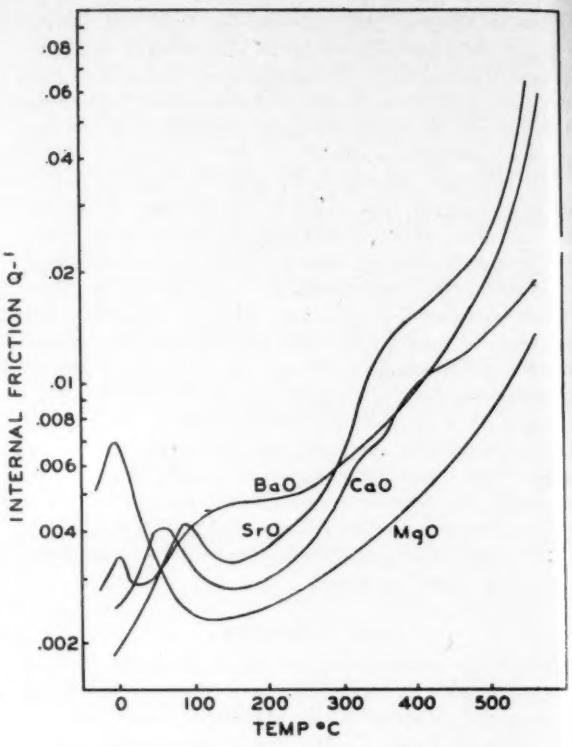


Fig. 6. Internal friction vs. temp.—Na_2O. RO. $5SiO_2$ glasses.

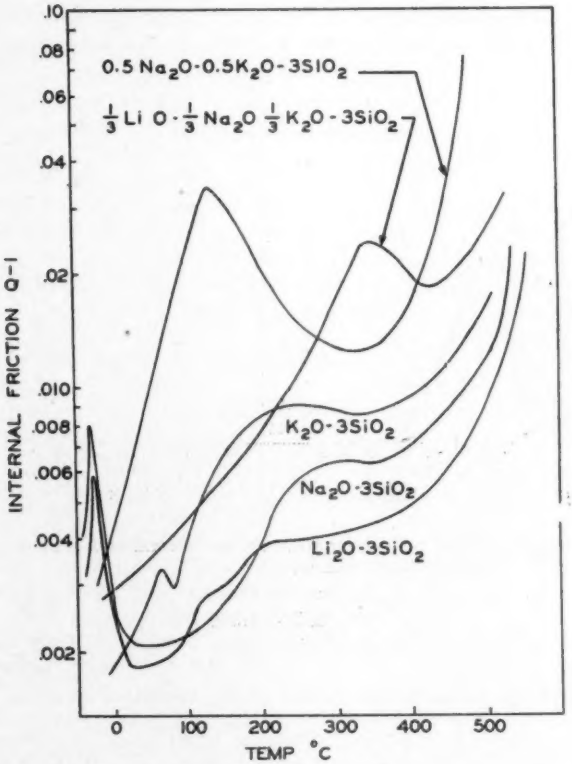


Fig. 5. Internal friction vs. temp. alkali-silicate glasses.

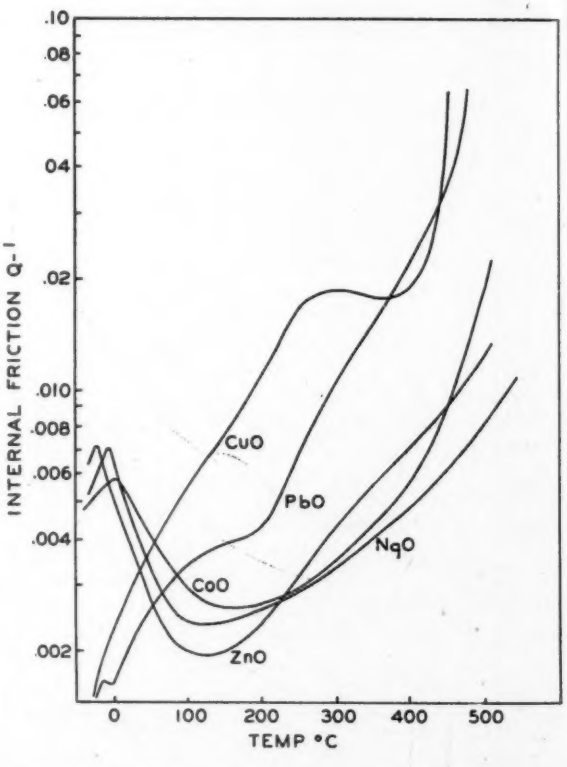


Fig. 7. Internal friction vs. temp.—Na_2O. RO. $5SiO_2$ glasses.

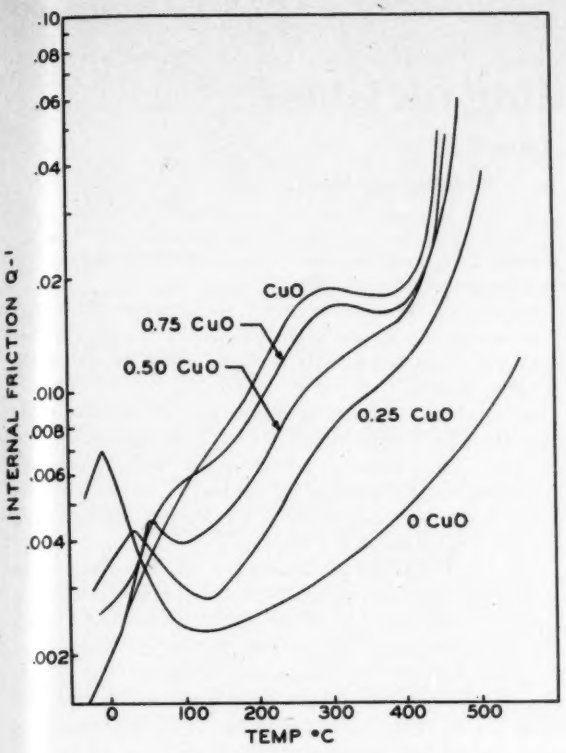


Fig. 8 Internal friction vs. temp. Na_2O (1-X) MgO. x CuO. $5SiO_2$ glasses.

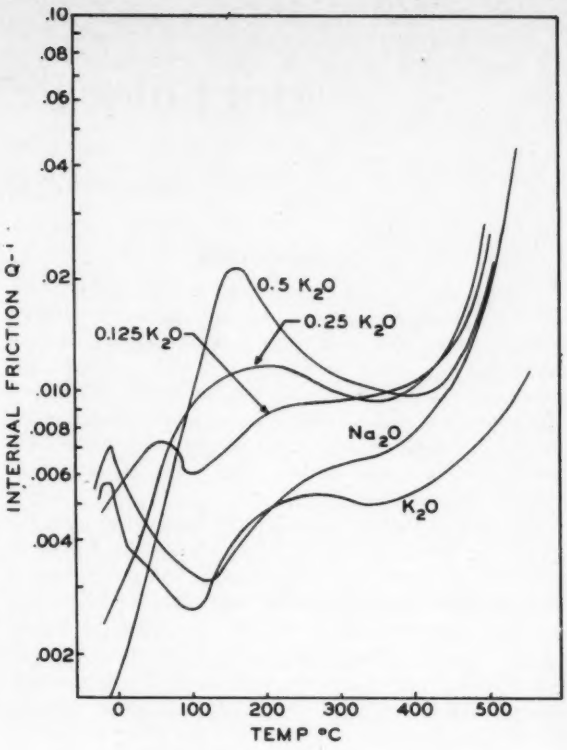


Fig. 9. Internal friction vs. temp. (1-X) Na_2O. x K_2O. MgO. $4SiO_2$ glasses.

glasses had an alkali peak at about 80°.

In the high temperature region, all three glasses gave characteristic broad peaks.

In the mixed alkali silicate glasses the low temperature alkali peak was eliminated and a very large maximum appeared at higher temperature.

e. Effect of Other Cations (Figs. 6-7)

Replacing MgO by CaO or SrO moved the alkali peak to higher temperatures. BaO decreased the internal friction value but did not change the temperature at which the peak occurred. ZnO and CoO had a small effect on the peak but replacing MgO by CuO or PbO had the effect of eliminating the peak. At the same time, the damping at higher temperature was greater in CuO or PbO glasses than in glasses containing alkaline earth cations. This is another manifestation of the tightening of the glass structure at low temperatures by replacing MgO or CaO by CuO or PbO. Similar effects can be seen in electrical conductivity or dielectric power loss[9].

Figures 8 and 9 show the effect of the gradual replacement of MgO by CuO in Na_2O-(2-x)MgO-xCuO-$5SiO_2$ glasses and the replacement of Na_2O by K_2O in R_2O-MgO-$4SiO_2$ glasses.

CuO had the effect of moving the alkali peak to higher temperatures until it merged into and disappeared in the large damping from 100-400°. Replacing Na_2O by K_2O produced a similar effect.

Replacing SiO_2 by Al_2O_3 (Fig. 10) caused a marked decrease in the intermediate temperature damping. The

(*Continued on page* 104)

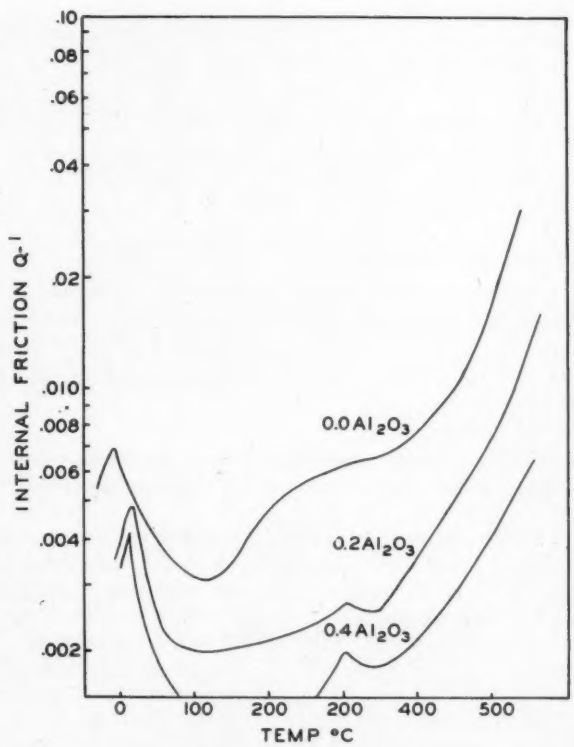


Fig. 10. Internal friction vs. temp. Na_2O. MgO. x Al_2O_3. (4-X) SiO_2 glasses.

Hot Color Printing on Glass

By A. W. SAMSON
B. F. Drakenfeld & Co., Inc., Washington, Pa.

INTRODUCTION

• In the past twenty years screen printing of ceramic color has been developed to a great degree. Increasing manufacturing costs and large volume production have stimulated the trend to automation with resultant improvements in glass decorating machines and color printing techniques. Colors containing a thermoplastic resinous vehicle have been of great benefit in the automatic printing of beverage bottles, other types of glass containers, and tumblers.

The glass industry in the United States first used the screen process in the early 1930's for the decoration of milk bottles. It was soon adapted to printing of beverage bottles and table tumblers. At that time, squeegee oils were composed of heavy natural oils, such as copaibas, linseed oil, Venice turpentine, wood rosin, etc. In late 1937 squeegee oils of the pine oil-ethyl cellulose type replaced these heavy oils, since better production methods required faster firing schedules and the newer synthetics did not contain heavy carbon-forming resins.

For the proper description of any process an understanding of terminology is important. A glossary of definitions will be found at the end of this article, but at this point a clear distinction should be made between hot and so-called "cold" colors. Therefore, based on current nomenclature, one may define them as follows:

Thermaplastic Colors or Hot Colors

Ceramic or vitrifiable colors dispersed in a thermoplastic composition which is solid at room temperatures but fluid when heated to 140°-200°F.

Conventional Color

Ceramic or vitrifiable color which has been mixed in paste form in squeegee oil. The color is printed without heat but must be dried if superimposed applications are to be made.

Cold Color

Paints, enamels, synthetics, or any non-fusing color. These usually require baking at low temperatures of 250° to 400°F.

In the conventional method of screen printing when multiple colors are to be printed, the color and oil mixture is screened on the article and subsequently dried. The drying process distills the low boiling fractions from the mixture, leaving a leather hard surface of color and resins suitable for overprinting. The use of conventional color necessitates extra handling of bottles, such as passing them through a drying tunnel or labyrinth type dryer. Colors applied with thermoplastic vehicles set hard enough to overprint instantly. This vehicle is a mixture of low melting waxes, resins, and solvents normally solid at room temperatures, but fluid at approximate temperature ranges of 140° to 200°F.

Melting of the solid material to workable fluidity is best achieved by means of an electrically heated, thermostatically controlled pot conveniently mounted above the printing stencil.

Removal of hot color misprints cannot be done satisfactorily with a wire buffing wheel. Although the use of the wire buffing wheel to remove dried prints applied by the conventional squeegee oil method is rather common practice, the heat generated by the buffing action causes the color print to melt and smear.

The recommended procedure for the removal of hot color misprints is to pass the bottles through a washing machine. Hot water at 160° to 170°F. containing a detergent type of cleaner will leave the bottles sparkling clean. As a general rule any commercial bottle washer will do a good job but one should be selected which does not leave a color film inside the bottle. It is very important that a boiler of adequate capacity be used to provide ample quantities of hot water.

The proper working temperature of thermoplastic-containing colors in the screen stencil is maintained either by radiant overhead heaters, or by electrically heating the insulated wire mesh of the stencil.

Radiant Heat

The source of radiant heat may be heat lamps, radiant heater coils, or rectangular heater plates. Regulation of the temperature is obtained either by adjusting the height of the heat source above the screen, controlling the electric energy input by an interval timer, or a combination of both.

Screen Resistance Method

The most generally used method of screen heating consists of making the insulated wire mesh of the stencil a part of a closed low voltage circuit. The stainless steel mesh of the stencil becomes heated as a result of the current flowing through it. By increasing or decreasing the input voltage the temperature is raised or lowered as required. This low voltage current may conveniently be obtained by a conventional device of one KW capacity for regulating the input voltage of an insulated transformer (115 volt, 15 volt 70 ampere secondary) the secondary of which is connected to opposite ends of the stencil.

The wire mesh forming the stencil must be completely insulated from the metal frame unless a non-metallic frame is used. With metal frames a convenient insulating procedure consists of sewing 1" or 1⅛" wide strips of cotton webbing along both long sides of the wire mesh. Then onto the free sides of the webbing strip are crimped conventional metal bindings which in turn are used to

fasten the mesh fabric to the frame. (Fig. 1) A metal binding is likewise attached to each short end of the same wire mesh and held down by ⅛" brass bolts passing through two rubber grommets set into each end of the frame.

Electrical connections from either end of the stencil to the transformer referred to above, may be made by either soldering the wire to the metal binding on the ends of the wire mesh or attaching conductive leads to the brass bolts.

The advantages of colors containing a thermoplastic vehicle are:

(1) Misprints are minimized.
(2) Sharper printing and fine detail can be achieved.
(3) Wrap-around and enveloping designs are now possible.
(4) Automatic decorating equipment construction can be compacted.
(5) Colors in "hot" medium are supplied ready to use; no further mixing is necessary.
(6) Machine operating speeds can be increased.
(7) Stencil cleaning or wash-out is reduced to a minimum. There is practically no evaporation of the hot color medium to leave clogging color residues in the detailed areas of the stencil.
(8) Two or more colors can be printed conveniently and economically without time loss between applications.

Disadvantages are very much outweighed by the advantages, but should be noted:

(1) An insulated and somewhat more expensive stencil must be used.
(2) Changing hot screens is somewhat more difficult. This becomes only a minor task as the operator gains experience.
(3) Hot water, containing a detergent, must be used instead of a wire buffing wheel to remove unfired, misprinted color. Water temperature should be approximately 170°F.
(4) Screen life is possibly somewhat shorter since formation of defects in the screen (such as pinholes) are accelerated. However, greater care in making screens, plus the use of improved film coating solutions helps increase screen life.

TYPES OF THERMOPLASTIC COLOR

Fat Working

When a color paste possesses an extreme amount of flow, even though it contains a minimum quantity of medium, it is said to be fat. Working characteristics are

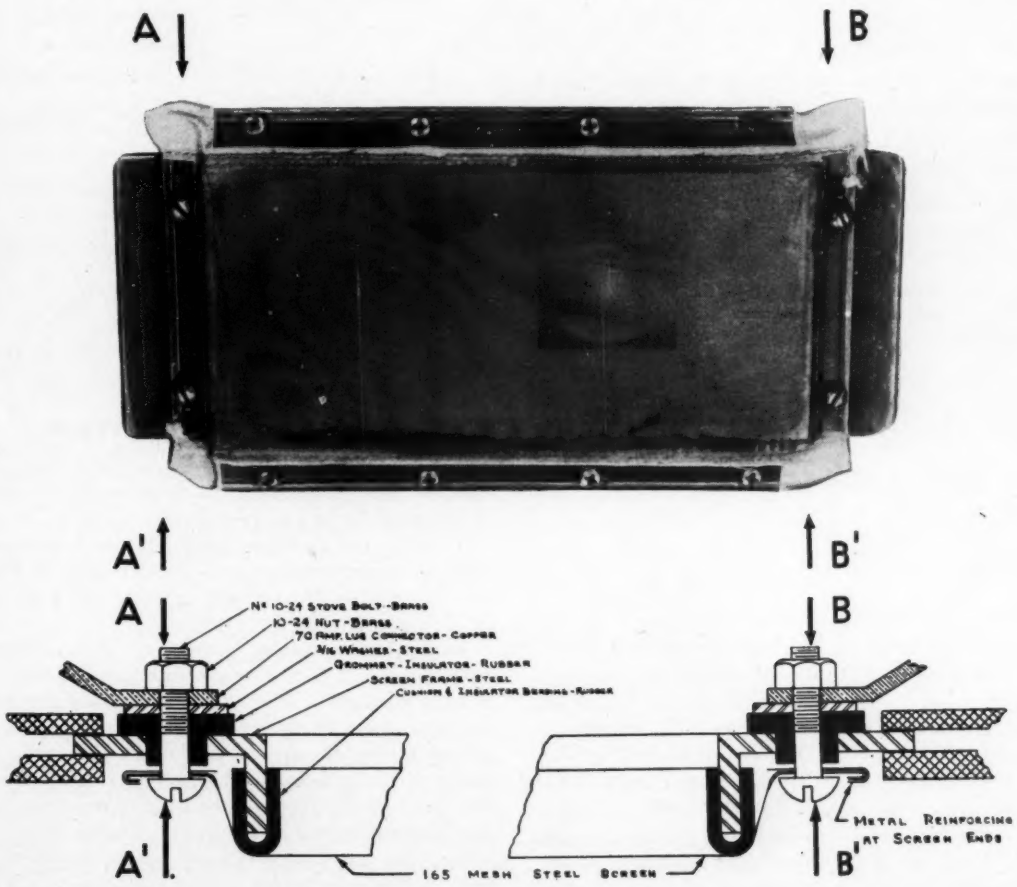


Fig. 1

similar to the conventional squeegee oil colors. Color rolls ahead of the squeegee and flows well through the stencil. After solidifying, this type of color leaves a minimum of screen marks on the article being printed. Dispensing the color to the screen should be automatic as "back-lapping" occurs when the screen is used as a reservoir. A "fat" medium has a tendency to run and sag under poor lehr preheating conditions.

Short Working or False Body

Short working pastes are the reverse of fat. They possess little or no flow even when the ratio of medium to color is increased to a relatively large amount. This color has a mayonnaise-like quality and shows more screen marks than the fat working type. It does not seep through the screen stencil when the machine is shut down for repairs or screen changes. Dispensing tubes should be at least 5/8 inch in diameter but the 3/4 inch size gives still better flow. A short working medium is used best on semi-automatic machines equipped with automatic spotting attachments.

Intermediate Type

Recently vehicles have been made which fall between the two classifications described above. These flow better than the short working mediums and yet are shorter than the fat working mediums. Although they may have a tendency to show a smear on the first two or three bottles put through the machine after a short work stoppage, they will never drip through. Generally, screen marks will show slightly after firing, although the color will level well if fired at the proper temperature.

DISPENSING EQUIPMENT

Item	*Supplier*
2 qt. Melting Pot. Cat. #402XCNVS	Sta-Warm Electric Co. Ravenna, Ohio
4 qt. Melting Pot Cat. #404XCNVS	Sta-Warm Electric Co. Ravenna, Ohio
50 watt Cartridge Heater (for dispensing tubes) #C201A-110 volts	Edwin L. Wiegand Co. 7500 Thomas Blvd. Pittsburgh 8, Pa.
75 watt Cartridge Heater (for squeegee) #C301A-110 volts	Edwin L. Wiegand Co. 7500 Thomas Blvd. Pittsburgh 8, Penna.
4 way Valve 385-MI	Ross Operating Valve Co. 120 E. Golden Gate Ave. Detroit 3, Mich.
a 5/8" dispensing copper tube from pot to a few inches above screen is recommended.	
Machines	
Completely Automatic Machine	Solar Engineering & Equipment Co. Beaver, Penna.
Automatic Attachments for Solar MSA	Lawrence Hagerman, Industrial Engr. 9048 East Telegraph Road Rivera, Calif.
	Solar Engineering & Equipment Co. Beaver, Penna.

SUPPLIES & SUPPLIERS

Item	*Supplier*
Grommet Insulator (rubber) No. B-6040 Black Rubber Bushing	Atlantic India Rubber Works 571 West Polk Street Chicago 7, Illinois
Cushion & Insulator Beading (channel rubber)	Stalwart Rubber Company Bedford, Ohio
Stainless Steel Wire 165 mesh to 200 mesh	W. S. Tyler & Company Cleveland, Ohio
	Factory Enterprises, Inc. P. O. Box 4025 Pittsburgh, Pennsylvania
Cotton tape or webbing Unbleached W-1023 in either 1" or 1¼" widths	Arbeka Webbing Company Pawtucket, Rhode Island
Completed Screens	Washington Stencil Products Company 4315 Summit Street Pittsburgh 1, Pennsylvania
Glass Fiber Yarn ECD-12	Owens-Corning Fiberglas Ashton, Rhode Island
Bottle Washers	Niagara Bottle Washer Mfg. Company 226 First Street Toledo 5, Ohio
	Solar Engineering & Equipment Company Beaver, Pennsylvania

(Assuming conventional metal screens are in use)

WORKING TEMPERATURES

The temperature range of thermoplastic mediums lies between 140° and 200°F. In most cases the best type is one which works at approximately 170°F., depending upon bottle and air temperatures. Just as a material with working temperatures of approximately 140° to 145° will not be suitable for summer, material working around 200° is not suitable for winter.

Dispensing equipment is necessary for automatic hot color operation. A melting pot with a dispensing tube 5/8 inch in diameter is recommended. For ease of operation, an automatic feed to control the amount of color flow to the screen should be employed. This will prevent the screen from being used as a reservoir for color and likelihood of drip-through and backlap when the machine is not operating will be minimized. Experimental work is being done in several plants using automatic valve operation for dispensing color.

(*Continued on page* 96)

Different Methods for the Determination of the Thickness of the Silver Film

By P. SEN & P. S. RAO
Department of Glass Technology, Banaras Hindu University, India

• A number of methods have been suggested for the determination of the thickness of the silver film of mirrors. J. B.[1] suggested the following processes: (1) inspection with the naked eye, (2) photo-electric cell, (3) appearance of the silver film, & (4) direct weighing method. Liepus[2] used the direct weighing method in finding out the thickness of silver film. Nifontova and Pototskaya[3] adopted the tirimetric analysis for the determination of the amount of silver deposited on a glass surface and calculated the thickness of the silver film. Gardner and Case[4] advocated the "Iodine Crystal Test" of Fizeau[5] in finding out the thickness of the silver film deposited on a glass surface.

In order to find a suitable method and to compare the various methods for the determination of the thickness of a silver film, the following processes were tried:—

(1) Volumetric analysis (by titration)
(2) Direct Weighing
(3) Fizeau's Iodine Crystal Test.

DETAILS OF THE METHODS

1. Volumetric Analysis (by titration)

The silver film on a glass plate was dissolved in dilute and hot nitric acid(1:4) and the solution was received in a beaker. The glass surface was thoroughly washed with distilled water to remove all the silver either in the solution or in the form of flakes. One ml. of fuming nitric acid was added and the solution was boiled for a few minutes and then cooled. Five drops of ferric alum solution were added as indicator and the liquid was titrated against a standard N/50 potassium thiocyanate solution.

From the amount of the silver deposited on the glass surface, the thickness of the silver film was calculated with the following formula:

$$h = \frac{W}{s} \cdot \frac{10}{g}$$

where h is the thickness of the silver film in millimeters
w is the weight of the silver in grams deposited
g is the glass surface in sq. centimeters
and s is the density of silver (10.5).

2. Direct Weighing

The cleaned and polished glass sheet was dried and weighed before silvering. The silver film was then deposited on the glass sheet. After washing the silver film thoroughly with distilled water and drying in an air oven at 110°C. it was cooled in a desiccator and weighed again. The process of drying, cooling and weighing was repeated to get a constant weight.

From the difference of the weights of the glass sheet after silvering and before silvering, the amount of the silver deposited on the glass surface was found. The thickness of the silver film was calculated by using the formula mentioned before.

3. Fizeau's Iodine Crystal Test

A very small crystal of Iodine was placed on a flat glass surface. A dry silvered glass sheet was placed on three nails, the silvered surface facing the iodine crystal but 2 mm. apart. After a few minutes, the iodine vapor converted the silver immediately above the crystal into silver iodide, thus producing a transparent spot in the film. Neighboring portions were partially converted into silver iodide and as a result when the film was viewed by reflected light, the transparent spot was seen surrounded by a series of concentric colored rings corresponding to the thickness of the layer of silver iodide. It was essential that the film be exposed to iodine until the central part of the pattern was transparent. According to Gardner and Case[4] a longer exposure increased the size of the pattern but did not increase the number of rings.

The number of rings present was a measure of the thickness of the silver iodide at the center of the pattern and this in turn was a measure of the amount of silver originally present; this was a measure of the thickness of silver film.

To determine the thickness of the silver film, the number of concentric ring systems was counted and reference was made to the following table:

Number of rings	Thickness ($X10^{-6}$) mm.
2	31
3	61
4	92
5	123
6	154
7	215

These values are derived by computations based on the relative densities of silver and silver iodide and on the refractive index of silver iodide.

EXPERIMENTAL

Several silver films of varying thickness were deposited on 3" x 2" (38.71 sq. cm.) of glass sheets (2mm. thick) and the thickness of each was determined by all the three methods given above. All the sheets were sub-

(*Continued on page* 112)

Japanese Pop Bottle

By DOROTHY BLAIR

• During the summer months, in fact all the year-round, one encounters in Japan bottled soft drinks—in small neighborhood shops, in city department stores, at resorts, in front of temples and shrines, in railway stations, on trains, in homes.

The containers, for the most part, are ordinary and uninteresting bottles. But there is one, used exclusively for *ramon-e* ("lemonade", but in our parlance, lemon pop) which has interested many a foreigner because of its unique and ingenious structure. It is, I think, produced chiefly in small, old style glass factories. It is fashioned into a bottle of two compartments and is invariably of thick and heavy, but transparent, dark green glass. The lower, and larger, compartment is empty and free, to receive the greater portion of the pop. In the upper, and smaller compartment, however, a glass marble, of the same green glass, has been inserted. When the bottle is empty this marble rolls about freely. Two inner projections at the short neck between the two compartments prevent its falling into the lower section, and two other inner projections above keep it from slipping into the bottle's mouth and closing it when the bottle is tipped for pouring or drinking. The projections were formed by pushing in the glass at those points, and the concavities thus formed on the exterior of the bottle provide convenient fingerholds.

Pop bottle of dark green glass. 7¾ inches high

When the bottle is filled with the liquid pop the marble serves as an automatic stopper, the effervescence of the drink forcing the loose marble up against a rubber gasket previously fitted, by hand, into a groove on the interior of the bottle's mouth. This forms a perfect closure, the marble remaining in position, as a tight seal, until a thirsty customer, using a simple instrument provided by the vendor, loosens it forcibly by a sharp jab. A simple strip of paper covering the top and pasted to the neck of the bottle presumably keeps the marble and the mouth-rim clean, while also advertising the maker of the pop.

This bottle has been produced in Japan for years, and was also imported to China for decades before World War II. Some Americans who grew up in China remember it as a familiar object of their childhood.

There are various production centers for this bottle, but the one I know personally is the Chugoku Garasu Kogyo Kabushiki Kaisha (The Industrial Glass Joint-stock Company of the Chugoku Area) in Okayama City, the only one of several Okayama glass factories which survived the war. This one dates from 1870 and is now operated not as a privately owned factory of the Uegaki family, as originally, but by the president of the company, Mr. Yoshiro Uegaki and his sons. Its size may be gauged by the number of its employees, thirty-two workers, plus an office staff of six. With the exception of a power-mill in the basement for pulverizing the raw materials and of two three-bottle compressed-air molding machines, all operations are by hand. The hours are from seven in the morning until four in the afternoon. The output varies according to the item being produced at any one particular time; but six workers whom I once saw making small medicine bottles blown in molds turned out an average of four thousand bottles a day.

The Chugoku Garasu Kogyo Kabushiki Kaisha, a small glass factory in Okayama City, Japan.

Interior of Chugoku Garasu Kogyo Kabushiki Kaisha factory.

Woman carrying bottles to the annealing oven pauses to record the production count by moving an equal number of glass marbles from one side of a partitioned box to the other.

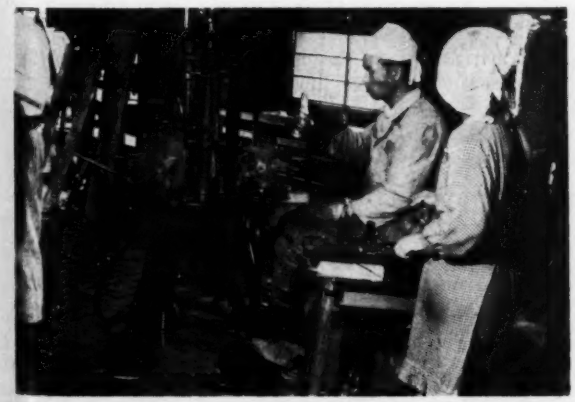
The six workers included two blowers, one woman operating two molds, two men finishing the mouths in small hand-held molds, and a woman who carried six or more bottles at a time to the annealing oven, and also stoked the furnace. As the bottles were carried to the annealing oven an equal number of marbles were moved from one side of a partitioned box to another, thus keeping track of production.

Raw materials are gathered from various places in Japan, with nitre imported from Chile. The products are milk bottles, medicine bottles and urinals, in addition to the pop bottle described. In the beginning, before the days of electricity, lamp chimneys were the main product of this factory.

There are many large glass factories in Japan, not unlike our American plants, turning out a tremendous amount of glass for an increasingly glass-conscious population, but these small privately owned, or joint-stock companies still survive. Working simply and modestly according to the old pattern they still seem to be a real part of Japan's economy.

Woman inspecting cullet brought in by a junk man and removing extraneous matter.

Woman inspecting finished bottles.



Worker operating a compressed-air, three-mold machine for bottles.

Woman wrapping finished products in straw. Later, these are baled in straw and shipped to various cities in the Chugoku area (western Honshu).

Inventions and Inventors

Glass Wool and Fiber

Metallized Glass Fiber Rovings. Patent No. 2,749,255. Filed May 24, 1952. Issued June 5, 1956. Two pages drawings; none reproduced. Assigned Commonwealth Engineering Company by Herman R. Mack and Howard J. Homer.

This invention relates to a method and apparatus for the deposition of metallic coats on strands of glass fiber. More particularly, the invention relates to the metallic coating of rovings of glass fiber.

The objectives of the invention are attained by providing for the heating of the glass fiber strand or strands to the decomposition temperature of a metal bearing heat decomposable gaseous compound and vibrating the heated strand in an atmosphere of the gaseous compound to attain a uniform deposition of the metal on each of the glass filaments comprising the strand. The imparting of a mechanical vibration to the strand spreads the filaments thereof and allows the gas to contact the filament surface intimately and uniformly.

The vibratory movement is preferably attained by drawing the material to be coated through the gas plating chamber, in a slightly taut condition, and then applying to the taut material a repetitive impulse which sets the strand into motion. The motion imparted is preferably as vigorous as the filamentary material will permit, for as the motion is increased the degree of spreading of the filaments increases, permitting rapid drawing of the strands through the plating area, thus enabling the achievement of high production speeds. While the speed of drawing is affected by other factors, such as the plating conditions, including the concentration of the metal bearing gas and the temperature of the roving, it may be stated that a drawing speed of 1 foot to 300 feet per minute is readily attained. Also the frequency of the impulses per minute applied to the moving roving is preferably relatively high and frequencies of 520 to 1750 impulses have been generally employed.

The plating conditions are in themselves not to be considered as critical. It is of course necessary that the material constituting the roving be heated to at least the minimum temperature of decomposition required for the metal bearing gas employed. It is also preferable that the plating gas flow countercurrent to the moving heated roving. It is preferred to use nickel carbonyl as the plating material. Other metal bearing gases such as copper acetyl acetonate, molybdenum carbonyl and chromium hexacarbonyl, as well as the metallic hydrides, are useful.

The operating pressures may vary over wide ranges from the subatmospheric to the atmospheric, but it is generally preferred to employ substantially atmospheric plating pressures, as operation under this condition permits the use of relatively simple apparatus.

There were 11 claims and the following references were cited in this patent: 1,710,747, Smith, Apr. 30, 1929; 1,987,577, Moers, Jan. 8, 1935; 2,251,913, Brennan, Aug. 12, 1941; 2,325,126, Giesler, July 27, 1943; 2,326,372, Lignian, Aug. 10, 1943; 2,344,138, Drummond, Mar. 14, 1944; 2,382,432, McManus et al., Aug. 14, 1945; 2,616,165, Brennan, Nov. 4, 1952 and Cline et al.: *Journal Electrochemical Soc.*, October 1951, vol. 98, #10 117-M. C., pp. 385-387.

Glass Fiber Product. Patent No. 2,748,028. Filed July 11, 1951. Issued May 29, 1956. One page drawings; none reproduced. Assigned Atlas Powder Co. by Henry M. Richardson.

It is an object of the invention to provide dry, resin bearing, glass fiber mats capable of being transformed directly by heat and pressure into reinforced thermoset masses.

Bonded glass fiber mats weighing two ounces per square foot and made up of multifilament glass fibers of approximately 0.00038 in. diameter, cut into lengths of approximately 2½ inches, laid down in random orientation and bonded with 8 per cent by weight of a cured coester of fumaric acid with 96 mol per cent of 2.2-di (4 beta hydroxy ethoxy phenyl)-propane and 4 mol per cent of glycerol was cut into strips 2½ inches by 6 inches. On one face of each strip approximately 0.7 gram of diallyl phthalate, containing dissolved therein 0.07 gram of tertiary butyl perbenzoate was sprayed, and on the other face 6.6 grams of powdered polyester resin was sprinkled. The polyester resin was the fumaric acid polyester of a mixed diol comprising 50 mol per cent of 2.2-di (4 hydroxy propoxy phenyl)-propane and 50 mol per cent ethylene glycol, ground to pass a 30 mesh screen. The treated strips were heated under infra-red lamps until the resin fused. The diallyl phthalate was largely absorbed into the fused particles of resin and on cooling to room temperature, resolidification occurred, resulting in a structure of glass fibers to which adhered a catalyzed polymerizable mixture of diallyl phthalate and polyester resin, which mixture was non-tacky, and somewhat flexible, lending strength to the structure as a whole.

16 piles of the resin bearing strips were laid up and compressed in a mold to a height of ½ inch and cured in a mold heated by 80 pound steam (324°F.) for 30 minutes. In the molded product the resin components had flowed together to form a continuous phase, and copolymerized to an insoluble, infusible mass heavily reinforced by the glass fibers. The surface was smooth and the plastic could be shaped by machining or sawing. It exhibited very high flexural strength and very low water absorption on immersion for 24 hours.

There were 13 claims and 11 references cited.

Glass Fiber Reinforced Molding Compositions. Patent No. 2,745,491. Filed May 16, 1952. Issued May 15, 1956. Three sheets drawings; none reproduced. Assigned Owens-Corning Fiberglas Corp. by R. H. Sonneborn and F. W. Dennen.

This invention relates to a process for the preparation of glass fiber reinforced resinous masses, as for example, a polyester resin molding composition reinforced by cut glass strands.

By the practice of the instant invention, because the strands are coated with the resin prior to cutting the strands into short sections, and because there is relatively little mechanical working of the resin coated glass fiber strands, the strands are not separated into individual filamets but maintained their integrity as associated groups of individual fibers with all of the fibers in each group closely adhered by the resinous mass. The resulting molding compound produces molded articles of higher strengths than is the case when extensive mechanical working and the resulting separation of the fibers within a strand result from the mixing step.

There were 3 claims and the following references were cited in this patent: 47,604, Phillips, May 2, 1865; 152,646, Kellberg, June 30, 1874; 242,207, Lyon et al., May 31, 1881; 1,110,238, Spiegel, Sept. 8, 1914; 1,581,236, Speer, Apr. 20, 1926; 2,010,078, Hale, Aug. 6, 1935; 2,026,533, Haupt, Jan. 17, 1936; 2,631,668, Wicker, Mar. 17, 1953 and Ser. No. 318,663, Bitterli et al. (A. P. C.), published June 8, 1943.

Reinforced Plastic Articles. Patent No. 2,746,896. Filed December 6, 1951. Issued May 22, 1956. No drawings. Assigned L-O-F Glass Fibers Co. by Henry C. Thompson.

This invention relates to reinforced plastic articles and to reinforced plastic articles having a high degree of transparency and to their methods of manufacture.

The coated glass mat was impregnated by enrolling it into a pool of catalyzed resin. The resin used in this was a commercial product sold under the name of Laminac by American Cyanamid Company, which is a polyester resin, to which had been added 9 per cent methyl methacrylate monomer. The resin was catalyzed with one-half per cent benzoyl peroxide and one-half per cent methylethyl ketone peroxide. In making up the aggregate, the liquid or plastic polyester resin containing 9 per cent methyl methacrylate was placed upon a sheet of cellulose and the coated glass mat placed thereon. A second sheet of cellophane was placed on top. The impregnated mat or aggregate was then placed between a corrugated metal mold and heat was applied in order to cure the core stock. The temperature was raised from approximately 85° to 250° over a period of about 30 minutes during which a light pressure of one-half pound per square foot was applied. After the corrugated plastic was cured, it was removed from the mold and the cellophane was stripped therefrom. The corrugated product produced transmitted approximately 80 to 85 per cent of the visual light striking it (air equal 100), and had substantially reduced internal haze.

There were 8 claims and 13 references cited.

Package of Curved Glass Sheets. Patent No. 2,743,010. Filed December 12, 1951. Issued April 24, 1956. Three pages drawings; none reproduced. Assigned to Libbey-Owens-Ford Glass Company by Melvin C. Koester.

The present invention relates broadly to the art of packaging and more particularly to a palletized shipping container for the storage and transportation of curved glass sheets.

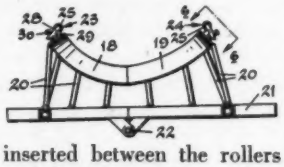
A pallet type bottom is provided of a new improved character. It is constructed in a manner whereby an interlocking engagement between the bottom, end and side sections is established. At the same time adequate bracing supports are maintained for each section and a completed container of exceptionally sturdy yet light construction is provided, cushioning means which conform to the general curvature of the glass sheets maintain the sheets in a substantially rigid cushioned relation with respect to the container walls. The container is further capable of complete prefabrication, is composed of a minimum number of parts that may be readily and quickly assembled at the situs of the loading operation. Other advantages of the container are its inexpensiveness and it is capable of receiving and transporting large number of sheets of glass-like material.

There were five claims and fifteen references cited.

Sheet and Plate Glass

Bending Glass Sheets. Fig. 1. Patent No. 2,746,209. Filed August 20, 1949. Issued May 22, 1956. Two pages drawings. Assigned to Libbey-Owens-Ford Glass Company by Emmett L. Walters.

This invention relates to improved outline or skeleton type glass bending molds and equipment for handling the molds, and in particular, to such equipment constructed in a manner and of such material that, in the desired forms, the structures will accurately retain their shapes without objectionable warping or growing during the repeated heating and cooling cycles to which glass bending equipment is subjected and will maintain a desirable temperature differential between the mold and the glass during use.



A flat sheet of glass is placed in bending relation to the mold of Fig. 1, the mold sections are separated by rotation on the hinge 22 until the glass sheet may be inserted between the rollers 25 of the locating devices 23 and 24. The mold itself is supported on the ends of the base 21 remote from the hinge 22 so that the glass sheet to be bent serves as a strut holding the mold in its open position. As the mold and the glass is passed through the furnace, the glass softens and sags thus permitting the mold to return to the position shown in Fig. 1 as the glass settles against the shaping surface.

A preferred composition of alloy for the cast metal bending molds is approximately 35 per cent nickel, approximately 15 per cent chromium, from 0.2 per cent to 0.5 per cent controlled carbon and the balance all iron except for traces of silicon, manganese, nitrogen (less than one per cent of each) and impurities often present in iron.

There were seven claims and the following references were cited in this patent: 1,107,476, Barot, Aug. 18, 1914; 1,190,652, Henderson, July 11, 1916; 2,003,383, Miller, June 4, 1935; 2,330,349, Galey, Sept. 28, 1943; 2,452,488, Paddock et al., Oct. 26, 1948, and 2,551,607, Jendrisak, May 8, 1951.

Filmed and Tempered Glass Sheets. Fig. 2. Patent No. 2,746,210. Filed December 6, 1952. Issued May 22, 1956. Two pages drawings. Assigned Libbey-Owens-Ford Glass Company by Romey A. Gaiser.

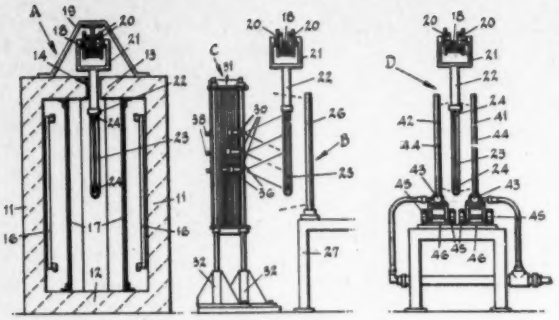


Fig. 2

The present invention relates broadly to the filming and tempering of vitreous bodies, and, more particularly, to a different method and apparatus by means of which improved heat strengthened glass sheets provided with electrically conducting surface films can be produced.

The glass sheet 23, after being hung within the frame 22 at the entrance end (not shown) of the furnace A, is introduced into, and passed through, the furnace by movement of the carriage 21 from right to left along the monorail 18.

With the glass sheet at the proper temperature, the heated sheet moves out of the furnace, and successively past the preliminary cooling mechanism B, the spraying mechanism C and into position to be acted upon by the final cooling mechanism D.

Passage of the glass sheet past the air pipe 26 will serve to preliminarily chill the real surface only of the glass sheet and this difference in temperature between the front and rear surfaces will cause the glass to bow slightly.

From the preliminary chilling mechanism B the sheet moves on past and is acted upon by the spraying mechanism C.

The stationary spray guns 30 are supplied with atomizing air through conduits 36 from air manifold 37 (not shown), and with filming liquid through conduits 38. The spray liquid may be any of the materials known to produce electrically conducting films upon contact with a hot glass surface but a 30 per cent solution of $SnCl_4$ in isopropyl alcohol is preferred.

Moreover, in addition to filming the glass, during passage of the sheet past the bank of spray guns 30, the action of the spray will also function to chill the filmed surface of the glass and so to overcome or counteract the bowing action of the preliminary chilling treatment and return the sheet to its original shape.

Continued movement of the glass sheet past the spraying mechanism will bring it into position for final chilling between the spaced heads 41 and 42 of the mechanism D where it is subjected to blasts of moving air directed against opposite surfaces simultaneously.

Their were eight claims and the following references were cited in this patent: 1,960,222, Long, May 22, 1934; 2,093,040, Eckert, Sept. 14, 1937; 2,236,911, Long, Apr. 1, 1941; 2,285,595, Littleton et al., June 9, 1942, and 2,478,817, Gaiser, Aug. 9, 1949.

Automatic Packing Apparatus for Glass Sheets. Patent No. 2,747,353. Filed January 5, 1953. Issued May 29, 1956. Four sheets of drawings; none reproduced. Assigned to Asahi Garasu, Kabushiki Kaisha by Sunao Shibata.

This invention has for an object an improved automatic packing apparatus for glass sheets, wherein the glass sheets are automatically fed into a crate wrapped in packing materials.

Glass sheets previously cut in suitable sizes are successively transported over a roll-gang; they are piled up on the roller frame in any suitable quantity with an extreme exactitude. Then they are forwarded on the rollers a definite distance, after which the glass sheets are fed into a crate in the holding frame which is horizontally positioned at the front of the conveyor and arranged with packing materials such as wood wool, straw, corrugated board paper and the like. Subsequently, the crate is returned to a vertical position with the holding frame, and the crate pushed out of the holding frame, packing material such as wood wool, straw, corrugated board paper and the like are placed on the open top of the crate and the cover is put thereupon to complete the packing operation. Thus, an integral operation from the feeding to the packing of glass sheets is achieved.

There were 8 claims and the following references were cited in this patent: 133,173, Penick, Nov. 19, 1872; 2,469,229, Gould, May 3, 1949; 2,613,021, Bowers, Oct. 7, 1952 and 2,633,280, Davies, March 31, 1953.

Cutting Glass Sheets. Patent No. 2,747,280. Filed January 5, 1953. Issued May 29, 1956. Three pages drawings; none reproduced. Assigned to Asahi Garasu Kabushiki Kaisha by Motoharu Kurata.

According to this novel invention, a glass plate carried on a continuously travelling conveyor approaches the cutting position; a guide frame carrying a traverse cutting tool then starts the advancement, first at lower speed in the same direction as that of the glass plate; then proceeds at the same speed as that of the glass plate to be cut or of the conveyor, simultaneously the traverse cutting tool for glass descends and the traverse cutting tool crosses the glass plate to accomplish the traverse scoring operation. When the traverse cutting or scoring has been completed, the engagement of the scored glass plate or the conveyor with the guide frame is released, which causes stopping the movement of guide frame and at the same time to lift the cutting tool. The slide bed remains at its position or allowed to return in the original position, while the guide frame returns in the starting position.

There were nine claims and 10 references cited.

Sheet Glass. Patent No. 2,755,212. Filed August 4, 1952. Issued July 17, 1956. No sheets of drawings. Assigned to Libbey-Owens-Ford Glass Company, by Wilbur F. Brown.

The present invention relates broadly to flat drawn sheet glass, and more particularly to a special glass of this general character, which has an unusually attractive color and improved absorption and transmission characteristics.

The special glare-reducing glass of the invention may be produced according to conventional procedures for drawing sheet glass in the flat by charging into the

Continued on page 117)

Research Digest

A New Process of Glass-melting by Introducing Flames into the Molten Glass

In common with all reverberatory furnaces the tank furnaces used in glass-works have poor thermal efficiency. By contrast, the utilization of heat is very economical in furnaces such as steel-works converters, in which the combustion occurs within the mass of the treated material. The difference in the thermal efficiencies is connected with the difference in the dimensions of the equipment for a given productive capacity. For example, a tank furnace may melt 132 tons of glass a day if the surface covered by the flame is approximately 1300 sq. ft., and the effective transmission 8300 B. T. U./sq. ft./hour. On the other hand, a steel-works converter, having a diameter of 8 ft. 6 inches, can treat 22 tons of steel in 20 minutes with an average hourly transmission of 8,000,000 B. T. U., i.e., 140,000 B. T. U./sq. ft./hour, or seventeen times as much as in the glass-tank furnace. Thus, if one could apply the transmission rates obtained in the converter to the problem of glass manufacture, the 132 tons of glass referred to could be melted in a pot having a surface of 77 sq. ft. (instead of 1300 sq. ft.) and a diameter of approximately 9 feet 10 inches.

A melting process which has lately been the object of extensive research finds its origin in the preceding comparison and is described by E. Brichard in the June 1955 *Journal of the Society of Glass Technology*.

The furnace comprises essentially in its lower part a glass-melting pot with a perforated base; the upper part is open. Fuel (generally gas) and air are brought through the perforated base by special pipes in such a manner that they mix intimately very near the upper face of the perforated base. The air and the gas, which are previously compressed, enter the mass of glass with a high velocity; they become thoroughly mixed, combustion soon becomes complete, and, as the heat is given off in a small zone, the combustion reaches very high temperatures. All these conditions—speed, high pressure and high combustion rate—enhance the heat-transmission rates considerably and lead to a high melting capacity for a plant of small dimensions.

The glass-melting pot normally contains molten glass up to a height of approximately 40 inches. The tumultuous passage of the incandescent gases creates an extremely energetic stirring of the molten mass, which swells on account of the large bubbles bursting at its surface and is traversed by canals which twist, open and close themselves, projecting waves of incandescent material like lava in a volcano. The preheating of the forced air increases as does the mean temperature reached in the pot, and causes the temperature on this sides of the "craters" to reach very high values. This is brought about by the important increase in the coefficients of heat transmission from the flame to the bath, while, as is to be expected, the transmission by conduction and radiation within the bath is relatively small. The internal radiation of the bath is, moreover, hampered by the fact that the glass of the inner surface of the craters, submitted to the action of the flames hurled at high speeds, reacts most vividly and transforms itself almost instantaneously into a coating of light foam, which is immediately blown to the surface and continuously replaced by fresh glass. This continuous renewal of the contact surfaces reduces the effect of the low heat conduction of the glass and, assisted by the turbulent motion, ensures a rapid diffusion of the heat in the mass of the glass.

The high-temperature zone is concentrated in the middle of the mass of glass, away from the sides of the pot and from its base, and this ensures conservation of the refractories, which would otherwise, owing to the high temperature and the turbulent motion of the glass, rapidly become unfit for service.

Watching the surface of the bath from above, one can observe the spasmodic motion of the glass, being continually disrupted by the flames piercing it and producing the effect of opening craters with incandescent side walls.

Since the gases leaving the bath are at a very high temperature, their sensible heat is great, and great importance is attached to the conservation of this heat; it is equally important to conserve as far as possible the heat radiated from the surface of the bath. To achieve these ends the following procedure is adopted: Over the pot is built a dual-purpose shaft, the top of which is designed both to allow the burnt gases to be exhausted and also to distribute the batch, which is previously granulated and dispersed in the upper part of the shaft. The batch falls through a stream of ascending exhaust gases, and thus is preheated; the density of the spray of granules is adjusted in accordance with the melting rate of the furnace. The density of the fluidized bed also increases as the particles are slowed down by the ascending gaseous stream. In practice, and under normal working conditions, the density of the cloud of batch particles obtained is such that no light can be seen when looking downwards from the top of the furnace; all radiation is thus cut off.

The particles of batch, being divided in the form of a spray, offer a large surface area for the exchange of heat by convection from the burnt gases; the convection coefficients are particularly favorable owing to the high relative speeds. A simple calculation, confirmed by experience, shows that if the rate and the efficiency of melting are high, conditions are obtained in which the batch absorbs the major part of the sensible heat of the burnt gases and is thus brought to a temperature near that of the bath before it mixes with the melt. Again, the temperature of the falling batch particles increases as they approach the bath; and similarly the temperature of the shaft lining progressively increases from the top to the lower part of the shaft. At a given level, therefore, the batch becomes pasty and tends to stick to the lining; but this trend is opposed by splashes of molten glass which is at a temperature high enough to wash the adhered material down into the pot, where it is quickly melted.

(*Continued on page* 118)

Hot Color Printing . . .
(*Continued from page* 88)

OPERATIONAL DIFFICULTIES AND SOLUTIONS

Backlapping

Occurs when the color is too fluid. It will result in a heavy, irregular application on one side of the label or decoration. The color is usually too hot or the medium is too fluid for the operation.

Blistering

Disruption of the enamel surface during firing. This may take the form of numerous eruptions in the color surface to a minimum change in color shading (such as exaggerated whiteness in a white color). Any form will be honeycombed with bubbles and resistance to alkali and acid is definitely impaired. The causes are:

(1) Use of a medium wherein one or more ingredients do not easily volatilize.
(2) Inadequate lehr preheat.
(3) Inadequate lehr ventilation.
(4) Lehr belt speed is too fast for conditions.

Crawl

A pulling away of the enamel from the surface of the bottle. This condition is caused by:

(1) Grease or foreign matter on the bottle.
(2) Color does not have correct physical characteristics.

Crizzle

The second print pulls into fine cracks. This usually is caused by the color, but can also be caused by moisture at the front end of the lehr.

Drip-Through

A drip-through of thermoplastic color through the stencil openings. Lowering screen temperature will stiffen the mixture, minimizing the drip-through.

Moiré Effect

A pattern in printing caused by too rough a first coat. The second screen then superimposes a like pattern over the first screen pattern, giving a wavy or water mark pattern. Is eliminated by a medium which flows better under the first screen or by using a 200 mesh first color screen, 165 mesh second color screen.

Pickup

A condition whereby the hot color applied by the first screen stencil adheres to or picks up on the underside of the second stencil and is redeposited on a subsequently printed bottle. This condition can be corrected by warming the second color screen either by resistance heating or focusing a heat lamp on the underside of it. Some thermoplastic media have more tendency to pickup than others.

Pinholing

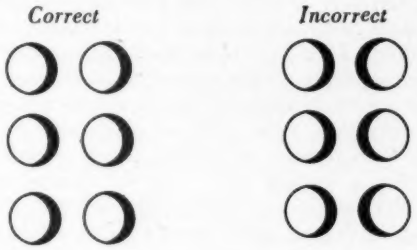
A hole in the ceramic coating extending through the color to the glass and about the size of a pin. This is usually caused by dirt, dust, or paper fuzz clinging to the bottle. In hot color printing, pinholes may be seen in the unfired color print but they usually close during the firing operation.

Running

A condition whereby, during the firing cycle, the color will actually run down the side of the bottle in droplets, or, in mild cases, show a build-up of more color on the lower edge of the print. This condition can be corrected only by changing to another and better medium.

Sag or Slump

A term referring to a minimum condition of running. In order to minimize this condition, the front label should face the back label when bottles are placed on a lehr. Since the front label is usually a large panel and should this panel face another large panel, the concentration of the evaporating vehicle might cause sag, slump, or running.



Scallop

A condition whereby the edges of a printed label give an uneven, scallop-like appearance. This condition can usually be corrected by proper reformulation of the color to suit lehr conditions.

Skin Finish

Can have two definitions: (1) A rough linen surface of the fired label. (2) Very minute blisters in the fired ware covered over by a smooth surface or skin. Can only be detected by knife scratching. Lowers alkali and acid resistance.

Can be corrected by: (1) A fatter medium and one which moves slightly in firing. (2) A better firing medium, or adjustment of lehr, to provide more time for the medium to burn out.

Slide

A condition whereby letters slide from their original printed position down the side of the bottle. It occurs only during firing and is caused by printing cold or moist bottles, and is aggravated by condensed moisture from open flame burners in the lehr preheat zone. This condition occurs more frequently with thermoplastic mediums than with conventional color.

GLOSSARY

Backlapping—A condition in printing whereby one side of a label is printed with a heavy coating of color.

Blistering—A condition in firing which may take the form of minute eruptions in the enamel surface. Lowers resistance of color to alkali and acids.

Body—Heavy or full appearance of the melted thermoplastic color. Similar to a heavy conventional paste.

Conventional Color—Color mixed in squeegee oil. A preferred term over the expression "cold color."

Coverage—In conventional color printing this term is applied to the number of gross of bottles printed per pound of color. In thermoplastic printing the term refers to the appearance of color on an applied color print. If many pinholes are seen coverage is not good.

Cracking—Closely allied to crizzle.

Crawl—A condition in which the color pulls away from the glass.

Crizzle—A condition not so severe as crawling and usually occurs in second color only.

Drip-Through—A drip-through of thermoplastic color through the stencil openings.

False Body—The melted color is "short" but does not have actual body.

Fat—A medium which flows well in the screen and usually has body.

Moiré Effect—A pattern in printing caused by too rough a first coat. The second screen then superposes a like pattern over the first screen pattern, giving a wavy or water mark pattern.

Pickup—A condition whereby the thermoplastic color printed by the first screen stencil adheres to the underside of the second screen stencil and is redeposited on a subsequently printed bottle.

Pinholing—In printing, pinholes may be seen in the first color print, but will usually close in firing. Pinholes showing up in the fired surface more than likely are the result of a contamination by lint, dust, and foreign materials on the surface to be printed.

Puff—Similar to false body. Has a mayonnaise consistency.

Running—A condition whereby the color runs down the side of the bottle.

Sag or Slump—A lessened condition of running.

Scallop—A scallop-like appearance in the top edges of a printed label.

Skin Finish—Can have two definitions:

(1) A rough linen surface of the fired label.

(2) Very minute blisters in the fired ware covered over by a smooth surface or skin. Can only be detected by knife scratching. Lowers alkali and acid resistance.

Slide—A condition where the printed letters will slide intact down the bottle. Caused from printing a moist bottle.

• J. Lockett has recently been appointed secretary of the Pilkington Glass Manufacturing Company, Ltd., Toronto.

• Robert C. Hayes has been appointed General Personnel Assistant for the L.O.F. Glass Fibers Company, it was announced by J. D. McGee, General Personnel Manager.

Cancer can't strike me,
I'm hiding.

What I don't know
won't hurt me.

Cancer?

Lots of people die of it, I know . . . but the American Cancer Society says a great many deaths from cancer are NEEDLESS *deaths. That's why I do what they tell me. I have an annual medical checkup however well I feel. I know the seven danger signals. And when I want sound information, I get it from my Unit of the*

AMERICAN CANCER SOCIETY

Current Statistical Position of Glass

Employment and Payrolls: Employment in the glass industry during November, 1956 was as follows: *Flat Glass:* A preliminary figure of 31,400 for November, 1956 indicates an increase of 1.0 per cent from the adjusted 31,100 reported for October, 1956. *Glass and Glassware, Pressed and Blown:* A decrease of 1.0 per cent is shown by the preliminary figure of 84,200 for November, 1956 when compared with 85,000 of October 1956. *Glass Products Made of Purchased Glass:* The preliminary figure of 15,900 shows no change from the previous month's figures.

GLASS CONTAINER SHIPMENTS

(All Figures in Gross)

Narrow Neck Containers

	Dec., 1956
Food	770,000
Medicinal and Health Supplies	1,247,000
Chemical, Household and Industrial	646,000
Toiletries and Cosmetics	708,000
Beverage, Returnable	636,000
Beverage, Non-returnable	85,000
Beer, Returnable	128,000
Beer, Non-returnable	539,000
Liquor	714,000
Wine	381,000
Sub-total (Narrow)	5,854,000

Wide Mouth Containers

Food	*2,661,100
Medicinal and Health Supplies	416,000
Chemical, Household and Industrial	147,000
Toiletries and Cosmetics	213,000
Packers' Tumblers	83,000
Dairy Products	201,000
Sub-total (Wide)	3,721,000
Total Domestic	9,575,000
Export Shipments	281,000
TOTAL SHIPMENTS	9,856,000

*This figure includes Fruit Jars and Jelly Glasses.

GLASS CONTAINER PRODUCTION AND INVENTORY

(All Figures in Gross)

		Production Dec., 1956	Stocks Dec., 1956
Food: Medicinal and Health Supplies; Chemical, Household and Industrial; Toiletries and Cosmetics	Narrow Neck	3,828,000	5,185,000
	Wide Mouth	*3,605,000	*4,403,000
Beverage, Returnable		590,000	1,133,000
Beverage, Non-returnable		70,000	153,000
Beer, Returnable		228,000	315,000
Beer, Non-returnable		549,000	569,000
Liquor		750,000	1,161,000
Wine		476,000	587,000
Packers' Tumblers		86,000	144,000
Dairy Products		220,000	274,000
TOTAL		10,411,000	13,924,000

*This figure includes Fruit Jars and Jelly Glasses.

Payrolls in the glass industry during November, 1956 were as follows: *Flat Glass:* An increase of 5.6 per cent is shown in the preliminary $15,994,532, when compared with October, 1956 adjusted to $15,139,791. *Glass and Glassware, Pressed and Blown:* A decrease of 0.9 per cent is shown in the preliminary $29,922,996, reported for November, 1956 when compared with the previous month's adjusted $30,207,300 figure. *Glass Products Made of Purchased Glass:* A preliminary figure of $4,863,015 was reported for November, 1956. This is the same as the adjusted figure of $4,863,015 of the previous month.

Glass Container Production: Based on figures released by the Bureau of Census was 10,411,000 gross during December, 1956. This represents a decrease of 12.7 per cent from the previous month's production of 11,934,000 gross. During December, 1955, glass container production was 10,166,000 gross or 2.4 per cent under the December, 1956 figure. During the full year of 1956, glass container manufacturers have produced a total of 142,784,000 gross. This is 4.8 per cent over the 136,261,000 gross produced during the corresponding 1955 period.

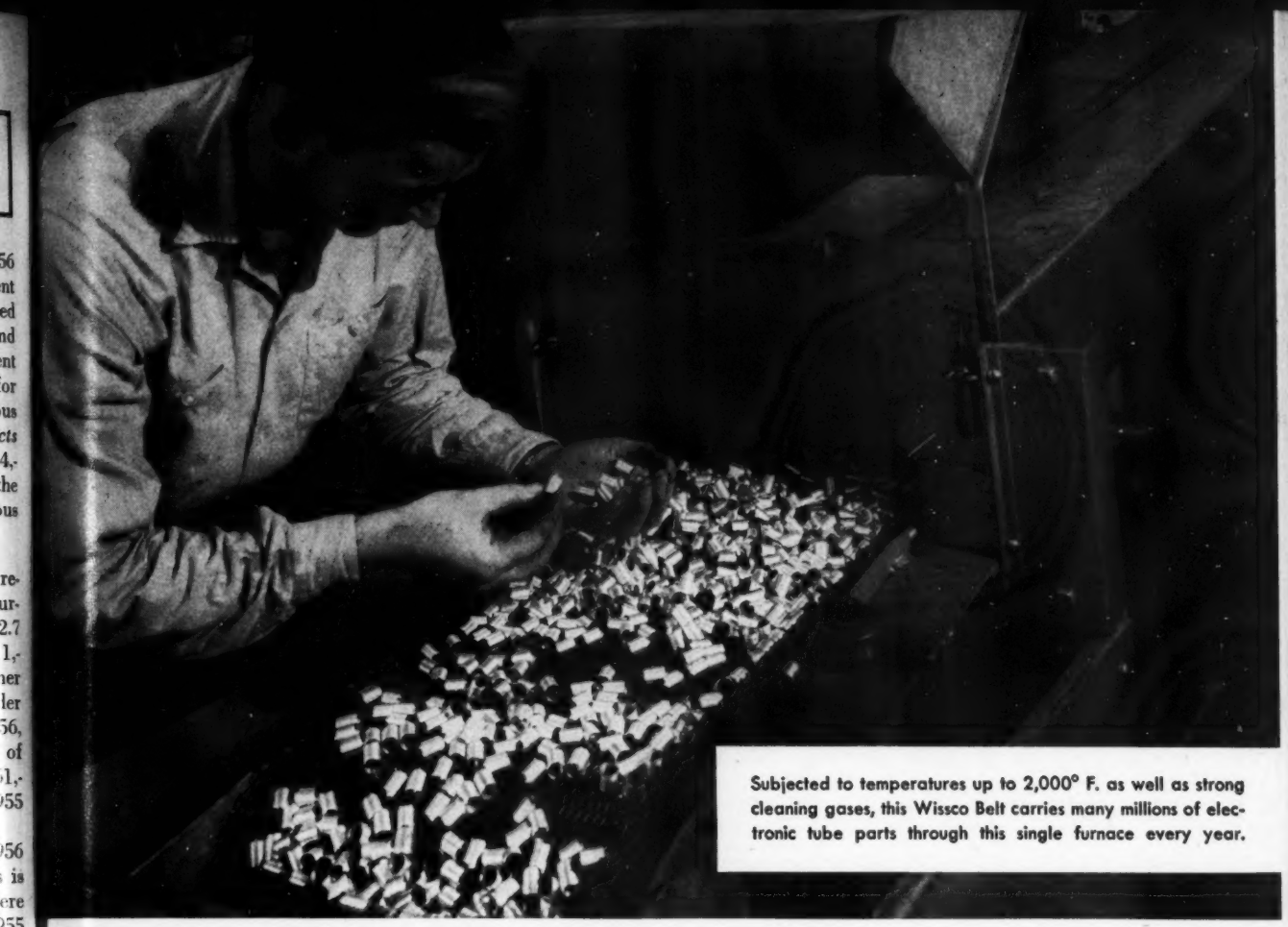
Shipments of glass containers during December, 1956 decreased 4 per cent a drop to 9,856,000 gross. This is a decrease from November, 1956 shipments which were 10,264,000 gross. Shipments during December 1955 were 11,579,000 gross or 17.2 per cent over December 1956. At the end of the full year of 1956 shipments have reached a total of 140,952,000 gross, which is 4.2 per cent over 135,219,000 gross shipped during the corresponding period last year.

Stocks on hand at the end of December, 1956 were 13,924,000 gross. This is 4 per cent above the 13,384,000 gross on hand at the end of November 1956 and 9.6 per cent higher than the 12,700,000 gross on hand at the end of December 1955.

Automatic Tumbler Production: During November, 1956 was 4,152,000 dozen. This is a loss of 23.5 per cent against the November, 1955 production which was 5,425,000 dozen.

Shipments during November, 1956 declined to 4,369,000 dozen. This is 16.8 per cent lower than the 5,253,000 dozen shipped during November, 1955. At the end of the twelve months period ending November 1956, shipments have reached a total of 54,193,000 dozen which is 13.1 per cent lower than the 62,352,000 dozen shipped last year.

Table, Kitchen and Household Glassware: Manufacturers' sales of machine-made table, kitchen and household glassware during November 1956 reached 3,442,000 dozen. At the end of the twelve months period ending November 30, 1956 manufacturers had sold a total of 33,241,000 dozen, which was 11.9 per cent lower than the 37,894,000 dozen sold during the corresponding 1955 period.



Subjected to temperatures up to 2,000° F. as well as strong cleaning gases, this Wissco Belt carries many millions of electronic tube parts through this single furnace every year.

FAMOUS NAMES
ride on WISSCO BELTS
Tung-Sol Electric, Inc. • Washington, N. J.

The story of Wissco Belts is best told by their users. For instance, Tung-Sol Electric reports:

"Our Wissco Belts performed without interruption for 4 years of continuous, 24-hour-a-day, 7-day-a-week operations . . . "

In spite of high temperatures and strong gases, that's the record of two Wissco Belts operated by one of America's well-known electronic parts manufacturers.

What's more, these two belts enabled Tung-Sol to increase production by 100% while reducing furnace feeder crews by 50%. "In a strictly cost accounting sense, the belts paid for themselves within a matter of weeks," according to the company's production control chief, Mr. Allen Mayberry. Yet the reliability of the belts is even more important, he points out, because millions of component parts used by the company each year must pass over one of these belts. "The Wissco Belts and the two electric furnaces in which they operate are so essential to our operation that our volume production quotas are based upon their output."

If you have any kind of processing or conveying operation, Wissco Belts can help you, too. Get the complete story today from the nearest sales office listed below.

THE COLORADO FUEL AND IRON CORPORATION
Denver and Oakland

WICKWIRE SPENCER STEEL DIVISION
Atlanta • Boston • Buffalo • Chicago • Detroit • New Orleans • New York • Philadelphia

CF&I OFFICES IN CANADA: Toronto • Montreal

WISSCO BELTS
PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION

CF&I

4371

New Equipment and Supplies

NEW RESEARCH MICROSCOPE

Bausch & Lomb Optical Co., 635 St. Paul St., Rochester, N. Y. has developed a new series of research microscopes with "push-button" illumination, said to permit faster and easier specimen analysis. Incorporating many of the firm's standard research design features, the series includes several major new developments, according to the firm, in substage equipment.

The new illumination system, the firm states, is the most important, since the speed, accuracy and ease of the operation stem from the use of unusually large lenses in the condenser, a graduated numerical aperture scale and a knurled ring for setting the lens system.

With the condenser in contact with a specimen slide, and with the correct illuminator, the field and numerical aperture of any objective from 30 mm to 1.8 mm can be filled. The need for auxiliary condensers to fill the field when a 30 mm, 3.5X objective is used, the firm states, is also eliminated.

Other features include: eyepieces fitted with rubber inserts to protect the user's glasses; a control location which enables the operator to make adjustments without raising his hand from the table; concentric coarse and fine focusing knobs for the substage; a cast iron microscope arm for increased rigidity; and a graduated pupillary distance scale on the binocular eyepiece.

Conventional Abbe and Panfocal condensers are also available. For photomicrography, measuring, microprojection and other special applications, a monocular body with a graduated draw tube can be substituted for the standard binocular body.

MOHR-TYPE PIPETTES

Corning Glass Works Corning, N.Y., is producing serological and measuring (Mohr type) pipettes with extremely accurate bores. The pipettes can be calibrated and marked in a single operation, the firm states, and are unaffected by sterilization as well as chemically stable.

Both graduations and sight lines of the pipettes are part of the glass and are said to remain legible for the life of the device. Double-beveled tips and uniform walls, unmarred by etched graduations are also included in the new pipettes, which are available in 1, 2, 5 and 10 ml capacities graduated in 1/10-ml, and in 1 ml graduated in 1/100-ml. The measuring pipette is also available in 25 ml in 1/10-ml.

SPRAY BOOTH FOR HORIZONTAL CONVEYORS

Henry G. Lange Machine Works, Inc., 166 N. May Street, Chicago 7, Ill., has introduced a new spray booth to permit modernization of silvering conveyors by conversion to completely automatic spray operation. Useful for automatic spray of tin, silver, copper and paint, the unit can be furnished for use on any width conveyor 24 in. to 144 in. and in any length, with the correct number of guns and air exhaust for conveyor speeds of 18 in. to 72 in. per minute or more.

Available with guns, manifold, reciprocating bridge with variable speed control stainless steel fittings and valves, it can also be furnished with a self-contained conveyor to match the speed of any existing conveyor.

NEW WATER DEIONIZER

Crystal Research Laboratories, Inc., 29 Allyn Street, Hartford 4, Conn., has a new model ion exchange water deionizer available. Non-mechanical and pressure operated, the unit is said to connect to any faucet and produces deionized water at a flow rate up to 2 gallons per minute.

Other features, according to the firm, include: jet feed with up-flow through resins for the prevention of channeling and insuring maximum efficiency and greater consistency; heavy duty polyethylene reservoir housing and working parts for durability and inertness; and resins as a filtering medium and as an indicator of exhaustion.

The new model has grain removal capacity of approximately 1600 grains as NaCl.

NEW LINE OF MOTORS

Reliance Electric & Engineering Co., 1088 Ivanhoe Road, Cleveland 10, Ohio, has introduced a new line of totally-enclosed air-over A-C motors intended to produce varying horsepower according to the application of varying air velocities. The effect is accomplished by the cooling effect of the air flow over the motor frame created by the fan or blower it powers; thus power output can be increased without exceeding the rated temperature rise of the motor.

CATALOGS RECEIVED

Link-Belt Company, Prudential Plaza, Chicago 1, Ill., has issued a booklet describing a newly designed oscillating conveyor which has been added to its line of light and heavy ranged conveyors for bulk materials handling. Especially engineered for applications in the intermediate ranges and capacities, the conveyors are described in Link-Belt's new book 2644. A capacity selection chart and engineering data and diagrams are included with dimensions and specifications of stock components. Requests should be directed to Dept. PR.

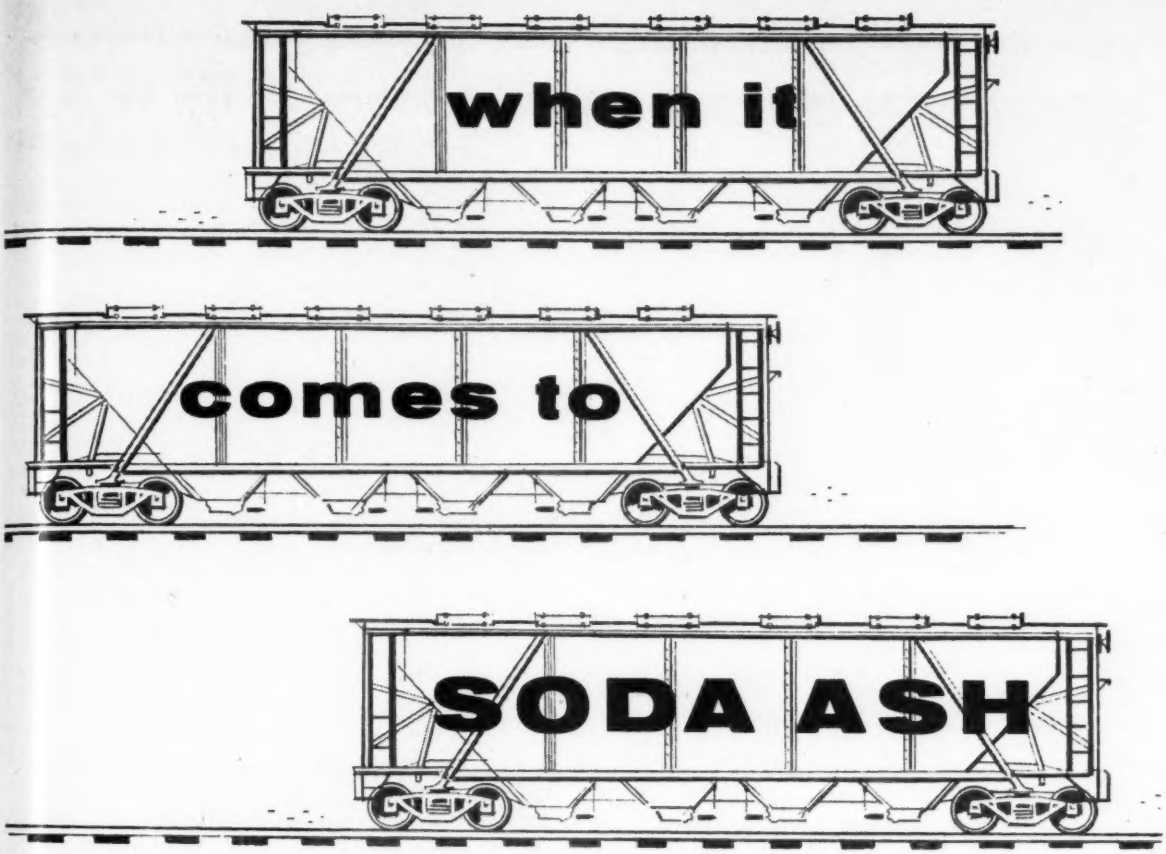
Brooks Rotameter Company, Lansdale, Pa., has issued bulletin 400 describing a new addition to its line, a positive displacement flowmeter suitable for hard-to-handle fluids such as bunker oils, still bottoms and asphalt. The bulletin describes the meter as available in sizes from 1 to 6 in., or up to 450 GPM capacity with temperatures up to 660 degrees and pressures up to 600 PSI. Accuracies are said to be guaranteed to 0.25 per cent in 1 in. sizes, and 0.5 per cent in 2 to 6 in. size meters.

Corning Glass Works, Corning, New York, has available a new publication which describes manufacturing methods, applications and the history of glass. Illustrated with charts, drawings and 130 photographs, the 64-page book has additional information, such as other publications and films available from the firm.

General Electric Company, Schenectady 5, N.Y., has published a 21-page, illustrated booklet, GER-1206, which consists of a series of six articles by R. M. Sills, of the firm's industrial heating department. Discussed are basic temperature control systems, thermocouples and control instruments, control elements and special control systems.

Fisher Scientific Company, 717 Forbes Street, Pittsburgh 19, Pa., has released the latest issue of *The Laboratory* in which are described new developments in laboratory instrumentation and technique. Published in two editions, one an industrial and the other a clinical edition, both are available free from the company. The feature of the former is an article entitled "Grease, Water and Electrons," which describes laboratory developments which have turned the graphic arts into graphic sciences. In the latter, a picture story describes Pasteur's growing contributions to the modern world. Each edition contains sections on new equipment in addition to other features.

Bailey Meter Company, 1050 Ivanhoe Road, Cleveland 10, Ohio, has a new four-page product specification E65-5 available describing the "Heat Prover" combustion analyzer which indicates per cent by volume oxygen and combustibles present in exhaust gases from all types of boiler and industrial furnaces. Operating and physical characteristics are provided, together with a list of accesories and other information.



you can count on Olin Mathieson

On-time deliveries . . . that's the Olin Mathieson hallmark. Over 60 years of making, handling and delivering basic industrial chemicals has given us unique foresight in anticipating your problems of supply, quality and quantity.

Mathieson soda ash means extras for you—in experience, in dependability, in the large, fast-moving fleets of hopper cars, box cars and barges. Ask your Olin Mathieson representative for the full picture today.

Mathieson dense soda ash is shipped directly from Wyandotte, Mich., and Lake Charles, La., as dense and intermediate dense in bulk carloads.

Mathieson coarse light soda ash, a special granulation developed for the glass industry, is shipped from Saltville, Va., in bulk carloads.

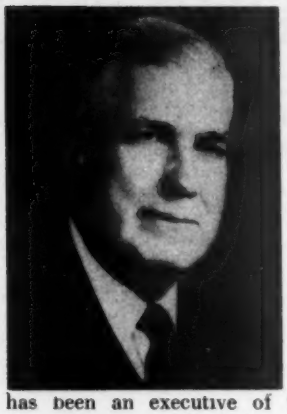
MATHIESON CHEMICALS
OLIN MATHIESON CHEMICAL CORPORATION
INDUSTRIAL CHEMICALS DIVISION • BALTIMORE 3, MD.

4683

MATHIESON

INORGANICS: Ammonia • Bicarbonate of Soda • Carbon Dioxide • Caustic Potash • Caustic Soda • Chlorine • Hydrazine and Derivatives • Hypochlorite Products • Muriatic Acid • Nitrate of Soda • Nitric Acid • Soda Ash • Sodium Chlorite Products • Sulphate of Alumina • Sulphur (Processed) • Sulphuric Acid
ORGANICS: Ethylene Oxide • Ethylene Glycols • Polyethylene Glycols • Glycol Ether Solvents • Ethylene Dichloride • Dichloroethylether • Formaldehyde • Methanol Sodium Methylate • Hexamine • Ethylene Diamine • Polyamines • Ethanolamines • Trichlorophenol • Surfactants

RICHARD TUCKER VICE PRESIDENT OF PITTSBURGH PLATE RETIRES



One of the most distinguished and colorful business careers in the flat glass industry came to a close recently with the retirement of Richard Tucker as vice president of the Pittsburgh Plate Glass Company. Mr. Tucker completed a half-century in the flat glass business which began in 1906 when he became manager of the John D. Gordan Company in Camaguey, Cuba. He has been an executive of the Pittsburgh Plate Glass Company since 1929 when he was appointed manager of glass sales for the company.

Mr. Tucker entered semi-retirement on January 3, 1955, when he relinquished the title of executive vice president of Pittsburgh Plate Glass Company. During the two-year interim period, he continued to serve as a vice president and supervised Canadian and foreign operations, the export department, glass division research, and as president of Glaces de Courcelles, Belgium.

He is a member of and for the time being will continue to serve on the boards of Pittsburgh Plate Glass, Columbia-Southern Chemical Corporation, Duplate Canada, Ltd., and Canadian Pittsburgh Industries, Ltd.

At the age of 70, Mr. Tucker now has decided to retire from all of his administrative responsibilities with the company and its subsidiaries and affiliates. He and Mrs. Tucker have established residence at Kingston Hall, Port Haywood, Virginia, where they will live in retirement. He plans to continue his activities in historical, educational and cultural fields.

Currently he is engaged in preparations by numerous groups to celebrate the 350th Anniversary in 1957 of the founding of the first permanent English settlement in America at Jamestown, Va. One of the projects will be a reconstructed version of the first glass plant in America which was built by the Virginia colony on Jamestown Island.

Mr. Tucker is serving as a member of the board of directors of the Glasshouse Foundation which has directed the reconstruction of the glass plant in cooperation with the National Park Service. This small and quaint glass-making facility will be in actual operation with glass workers dressed in costumes of the 1607 period, and will produce small bottles and other glass objects from the facilities that have been constructed as a replica of the original plant which was America's first industry. Pittsburgh Plate Glass Company is one of the many glass firms throughout the country which are sponsoring members of the Glasshouse Foundation.

• The Latchford-Marble Glass Company has recently changed its corporate name to Latchford Glass Company.

• Howard H. Ward, controller, Ball Brothers Company, Inc., Muncie, Indiana, has been elected to membership in the Controllers Institute of America.

NEW BOOKS

Glass Manufacture in Old Russia (*in Russian*) M. A. Bezborodov. Acad. of Sciences, Byeloruss. S.S.R.

This book contains more than its title promises. The author, who published another book and many papers on the history of glass before producing this conclusive volume, first discusses the manufacture of glass in antiquity and in the early medieval time, after which the art of glass making reached what now is Russia. Then a review of Russian glasses prior to 1240 A. D. is given. In the third chapter, on the methods of examination of glass and refractories, the glass technologist in Professor Bezborodov takes the pen over from the archeologist. The next two chapters bring results of study of old Russian refractories and glasses, respectively, and attempts to reconstruct, from their data, the raw materials and the methods used by the glassmakers of old.

The literature cited includes publications in Czech, Dutch, English, French, German, Polish and Russian.

Bezborodov's monograph seems invaluable for every historian of glass. It is hoped that language difficulties will not prevent the non-Russian specialists from reading and using it. Minsk 1956. 306 pages, 37 illustrations. Price: 10.6 rubles.

H. F. MERRITT VICE PRESIDENT SOLVAY DIVISION RETIRES

H. F. Merritt

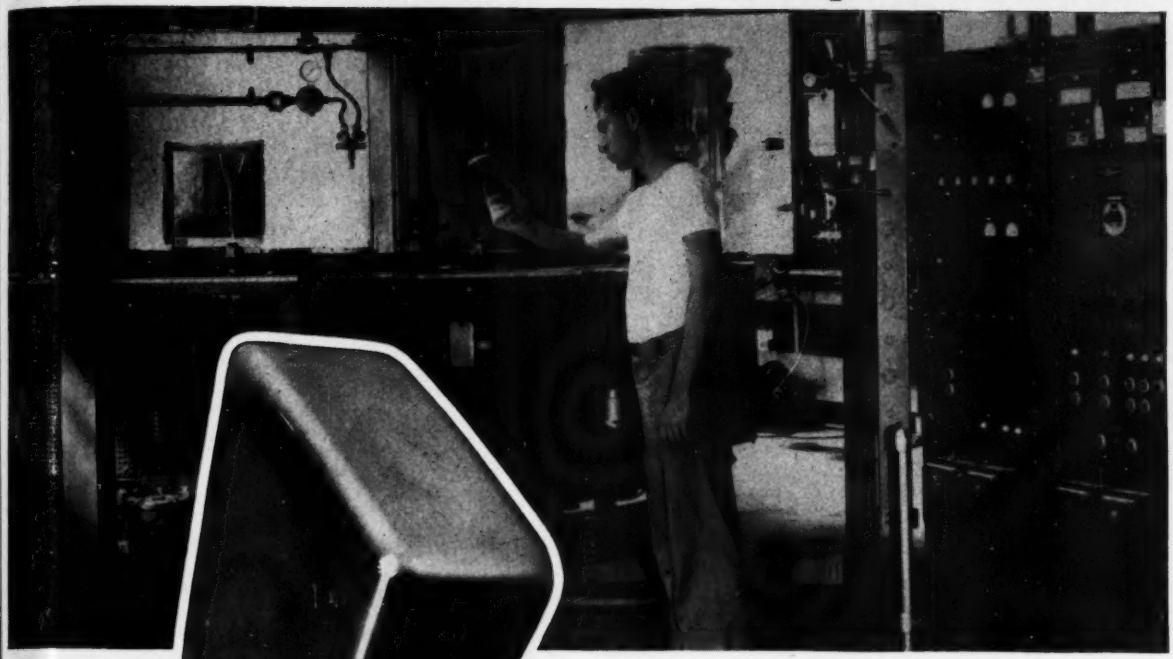
L. B. Gordon

Retirement of Harold F. Merritt, vice president of Solvay Process Division, Allied Chemical & Dye Corporation, effective December 31, 1956, was announced by Carlton Bates, president of the division. At the same time appointment of Lester B. Gordon, a Solvay vice president, as head of that company's sales organization, effective January 1st, 1957, was announced.

Mr. Merritt's entire business career of over 43 years, has been spent with Solvay. He first joined the organization in 1913 after obtaining his Chemical Engineering degree at New York University. Mr. Gordon has spent almost all of his business life in sales work. His service with the company dates back to 1915. For many years he was located in Chicago and was western sales manager from July 1931 until May 31, 1937 when he was transferred to the New York office as assistant director of sales. He became director of sales in February 1947 and was appointed a vice president a few years later.

• Appointment of Philip F. Datz to the newly-created position of supervisor of construction accounting has been announced by Pittsburgh Plate Glass Company.

Waterman outgasses Rayonic® cathode ray tubes at the rate of one every 3 minutes



... and uses Selas Gradiation® Heating in reducing pressure to 10^{-6} in. Hg

Waterman Products Co., Inc., makes cathode ray tubes, known for their long life and brightness, for use in highest quality, compact oscilloscopes where accuracy and miniaturization are requisites.

In setting up continuous production equipment, Waterman selected Selas Gradiation Heating for the control and uniformity necessary in outgassing to hard vacuum at high speeds.

Waterman also employs Selas Gradiation Heating to preheat the tubes prior to fusing tube ends to bases; and to control cooling following the joining operation.

Selas Gradiation Heating is used throughout the glass industry to anneal, temper, fire polish, form, bake coatings and for many other operations where preciseness and uniformity are essential. Write and ask how it can be applied to your needs. Address Dept. 192.

SELAS
CORPORATION OF AMERICA
DRESHER, PENNSYLVANIA

Heat and Fluid Processing Engineers

DEVELOPMENT • DESIGN • CONSTRUCTION

(*Continued from page* 85)

alkali peak was not affected very much. The gradual replacement of SiO_2 by B_2O_3 was also studied and the results are shown in Fig. 11.

The replacement of MgO by CuO and Na_2O by K_2O was also studied in an $Na_2O.2MgO.Al_2O_3.6P_2O_5$ glass (Fig. 12). The same effects were present but to a smaller degree than in the silicate glasses studied.

IV. DISCUSSION

The internal friction can be caused by shifts in position of ions, e. g. alkali ions. Lithium, sodium and potassium have characteristic peaks in glasses when their internal friction for a given frequency is plotted against temperature. These peaks are affected by the other constituents of a glass in a way which has its parallel in electrical conductivity and dielectric power loss. The presence of more than one kind of alkali or of Pb^{2+} or Cu^{2+} ions is responsible for a tightening of the glass structure at ordinary temperatures—so that the normal alkali response disappears.

At temperatures between those where the alkali peaks are observed and those where glasses actually flow, a second series of internal friction peaks or very high values of internal friction are observed. These values are especially high in Pb^{2+} or Cu^{2+} glasses and peaks are particularly pronounced in mixed alkali glasses.

The occurrence of these peaks could be due to the presence of large atomic groupings which are separated from

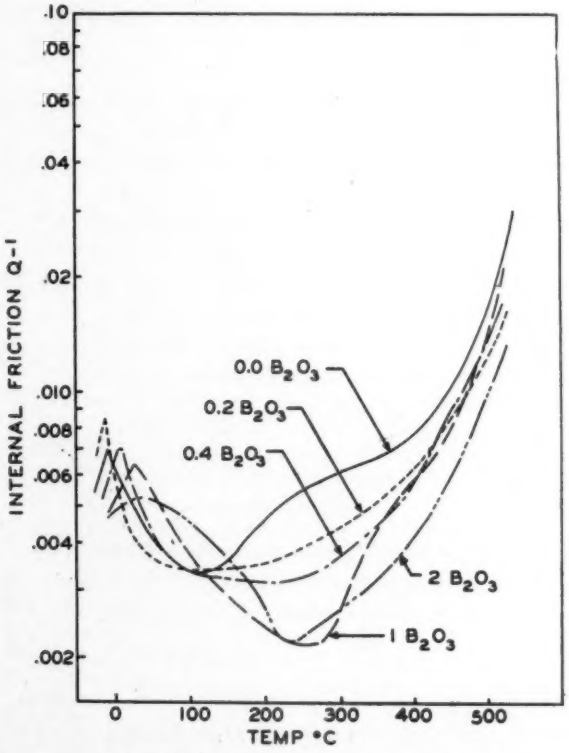


Fig. 11. Internal friction vs. temp. $Na_2O.\ MgO.\ x\ B_2O_3.\ (4–X)\ SiO_2$ glasses.

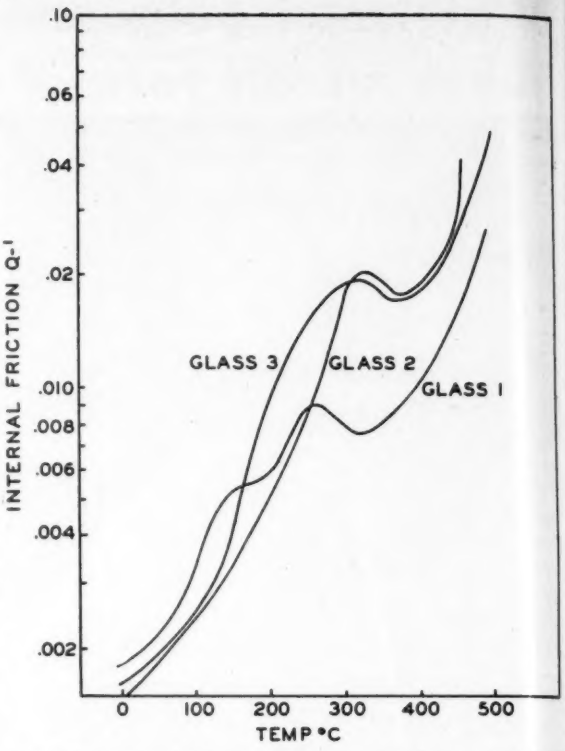


Fig. 12. Internal friction vs. temp. aluminum phosphate glasses:
1—$Na_2O.\ 2MgO.\ Al_2O_3.\ 6P_2O_5$.
2—$Na_2O.\ 2CuO.\ Al_2O_3.\ 6P_2O_5$.
3—$O.\ 5Na_2O.\ O.\ 5K_2O.\ MgO.\ Al_2O_3.\ 6P_2O_5$.

the network and can lag behind the network oscillations. These groupings are thought to be similar to the 35° A clusters observed by Prebus[10] with the electron microscope and also to be the factor responsible for the 40 Angstrom discrete scattering observed with low angle X-rays by Hoffman and Statton[11]. Other possibilities are stress induced orientation effects and the diffusion of other ions, particularly O^{2-}.

The electrical properties of glass are closely related to the internal friction. The relaxations giving internal friction peaks involve the motion of charged particles, ions, and the dielectric power loss shows similar effects to the internal friction. The electrical conductivity which depends on the mobility of the alkali ions parallels the internal friction.

The relaxations giving rise to internal friction effects can give small volume changes over long periods of time. It is known that thermometer glasses should contain only one kind of alkali in order to prevent changes in fixed points with time. The large internal friction peaks observed in mixed alkali glasses are probably the basic cause for these secular changes. For dimensional stability, with respect to stress induced changes, glasses with low internal friction should be chosen.

V. REFERENCES

(1) C. E. Guye and S. Vasileff, *Arch. Sci. et Nat.*, 37, 214 (1914).
(2) H. Rotger, *Glastech. Ber.*, 37, 578 (1936).
(3) K. Bennewitz and H. Rotger, *Physikal. Z.*, 37, 578 (1936).
(4) J. V. Fitzgerald, K. M. Laing and G. S. Bachman, *J. Soc. of Glass Tech.*, 36, 90 (1952).

(5) F. Horton, *Phil. Trans.*, 204A, 407 (1905).
(6) J. V. Fitzgerald et. al., loc. cit.
(7) J. P. Poole, *J. Am. Ceram. Soc.*, 32, 215 (1949).
(8) C. Zener, Elasticity and Anelasticity of Metals, *U. of Chicago Press* (1948).
(9) R. R. Shively, Ph.D. Thesis, Division of Ceramics, The Pennsylvania State University (1951).
(10) A. F. Prebus and J. W. Michener, *Indust. Eng. Chem., No. 1, 146* (1954).
(11) L. C. Hoffman and W. O. Statton, *Nature, 116,* 561 (1955).

250-YEAR-OLD BEER BOTTLES PROVE DURABILITY OF GLASS

Eighteen bottles of beer coming up, after 250 years under the sea, recently added a dramatic chapter to the story of glass containers' remarkable strength and durability.

At the tail-end of recent storms that battered the British Isles, odd squat-shaped green glass bottles began bobbing their way to shore along the coast of Kent. Unprotected, tossed and beaten by giant waves, the sturdy bottles landed unscathed and were picked up in various spots along the beaches from Walmer to Pegwell Bay.

Experts easily identified the strangely shaped glass containers as the type that were made by hand about 250 years ago. Some of the bottles, still tightly corked and wired, contained an ale which conservative British tasters described as "strong."

The mystery of what these hand-blown bottles had been doing in Davy Jones' locker for two and a half centuries was recently solved by a search of Lloyds' archives. Records show that in 1703 a ship belonging to Captain Thomas Bowrey set sail for India with a cargo that included bottled beer. But early in the 18th century, Captain Bowrey's ship was wrecked on the Goodwin Sands, just off the coast of Kent. The Captain's beer, safely sealed and protected in glass containers, sat under the sea for 250 years. Evidently, gales broke the cargo loose, and sent the sturdy bottles on their tempestuous trip to shore.

Today, more glass containers are machine-produced every six hours than were puffed out by lung power in an entire year at the time these bottles were blown. But the ancient and rugged bottles, shown here, set prophetic standards for glass packaging's strength and durability.

The glass container on the right of the picture has kept its original contents intact. The bottles shown are in the possession of Mr. Ivor Noel-Hume.

CORNING GLASS TO BUILD NEW APPARATUS PLANT

Corning Glass works will build a new apparatus plant in the Corning area it was announced by W. C. Decker, company president.

The one-story, 176,000 square feet factory will manufacture Pyrex brand laboratory ware and will employ approximately 500 people initially. The factory will include offices, cafeteria and warehouse.

Construction is expected to begin in spring and the plant will be in operation at the end of the year.

Mr. Decker said the new plant will be much larger than the present apparatus factory located in Corning and production capacity will be even greater because of improved manufacturing facilities and plant layout.

• George P. MacNichol III, staff member of the production policy committee of Libbey-Owens-Ford Glass Company, has been named a vice president of the Rossford Savings Bank.

R. A. HORNING RETIRES, FOUR OTHERS PROMOTED AT ARMSTRONG

R. A. Horning

R. H. Hetzel

The retirement of Roy A. Horning, assistant general manager and production manager of the Armstrong Cork Company's Glass and Closure Division, effective February 1, after 42 years of service with Armstrong, has been announced by J. C. Feagley, vice president and general manager of the Glass and Closure Division.

He began his career with this firm as a ceramic engineer in the company's Beaver Falls, Pa., plant in 1914 following his graduation from the University of Illinois.

Roger H. Hetzel has been appointed to succeed Mr. Horning as assistant general manager of the Glass and Closure Division in addition to his present responsibilities as general sales manager. Mr. Hetzel joined the Armstrong organization in 1935 following his graduation from the Pennsylvania State College. He has served in a number of assignments including field sales, cost accounting, munitions, and glass container sales management.

W. W. Pedrick, III, manager of the Armstrong Plant at Millville, N. J., will succeed Mr. Horning as production manager of the Glass and Closure Division. He joined the firm in 1939.

Roger F. Scott, assistant plant manager at Millville, has been named to succeed Mr. Pedrick as plant manager there. Mr. Scott joined the firm in 1940.

Walter W. Sheridan, chief industrial engineer for Armstrong industrial products plants, will succeed Mr. Scott as assistant plant manager at Millville. Mr. Sheridan has been with the Armstrong organization since 1947.

R. F. Scott

W. W. Pedrick, III

JAMES E. MAYABB APPOINTED GIA PUBLICITY DIRECTOR

The appointment of James E. Mayabb as director of publicity of The Glassware Institute of America was announced by R. L. Davis, secretary and treasurer of the American Glassware Association.

Mr. Mayabb will help establish a new publicity and promotion program for manufacturers of machine-made tumblers, kitchen and cooking glassware.

He was recently with Sumner Rider & Associates, industrial public relations firm.

He has been on the editorial staff of Good Housekeeping Magazine and was a member of the original editorial board of Mademoiselle's Living which later became Living For Young Homemakers.

The pressed and blown glassware industry with shipments valued at over $370,000,000 a year is represented by the American Glassware Association of which the GIA is the largest segment. Members of GIA include: Anchor Hocking Glass Corp.; Bartlett-Collins Co.; Corning Glass Works; Federal Glass Works; Hazel-Atlas Glass, Div. of Continental Can Co.; Indiana Glass Co.; Jeannette Glass Co.; Libbey Glass Div. of Owens-Illinois.

GIA publicity was formerly handled by Robinson-Hannagan Associates, but will now be carried on through the Glassware Institute office of the American Glassware Association, 19 West 44th St., N.Y. 36, N.Y.

J. N. HINYARD APPOINTED DIRECTOR FOR AMERICAN POTASH

James N. Hinyard has been appointed director of market development for American Potash & Chemical Corporation, according to an announcement by Daniel S. Dinsmoor, vice president in charge of planning and development.

Hinyard replaces Dr. A. J. Dirksen who recently was named general sales manager of the company's Industrial Chemicals Division. He will make his office at AP&CC headquarters at Los Angeles.

Hinyard, who holds B.S. and M.S. degrees in chemical engineering from the University of Texas, at Austin, formerly was with Merck & Company, Inc., at Rahway, N. J., where he was responsible for market research and development of new and existing products.

• James R. Bachman, a specialist in refractory materials, has joined the staff of the ceramics division at Battelle Institute, Columbus, Ohio. He was formerly employed at the Applied Research Laboratory of U. S. Steel at Pittsburgh.

ROBERTS APPOINTED EXPLORATION DEPARTMENT HEAD AT LACLEDE-CHRISTY

Walter D. Roberts has been appointed head of the exploration department for the Laclede-Christy Company Division, H. K. Porter Company, Inc.

Mr. Roberts will direct the development of raw material reserves for the manufacture of refractories at all Laclede-Christy works which are located in Missouri Illinois, Alabama, Pennsylvania and Colorado.

LITHIUM PROMOTES SIX EXECUTIVES

The appointment of four new vice presidents and the elevation of two to the newly created position of senior vice president, has been announced by Herbert W. Rogers, president of the Lithium Corporation of America.

Named vice presidents, effective January 1, were: Dr. R. B. Ellestad, director or research; Walter M. Fenton, director of product research and development; J. Dean Herman, director of chemical plant operations, and J. D. Campbell, director of sales.

Willis W. Osborne, treasurer, and Fremont F. Clarke, general manager of operations, the company's two vice presidents, were appointed senior vice presidents.

ENGINEERING DIRECTOR FOR FMC CHEMICALS

Robert J. DeLargey, resident manager of Food Machinery and Chemical Corporation's Westvaco Chlor-Alkali plant at South Charleston, West Virginia, has been promoted to the post of director of Engineering for FMC's Chemical Divisions, it was announced by Dr. Carl F. Prutton, executive vice president. The appointment was effective January 1, 1957. Mr. DeLargey will be responsible for major plant design and construction, process development, and industrial engineering activities for all the Chemical Divisions of FMC including the Westvaco Chlor-Alkali Divisions.

Neil C. Elphick, general superintendent at South Charleston, will be the new resident manager at the plant succeeding Mr. DeLargey. Mr. Elphick came to South Charleston early in 1955 after serving on the engineering staff of the FMC Chemical Divisions administrative offices in New York City.

O. HOMMEL COMPANY AWARDS EMPLOYEE SERVICE PINS

Forty-four employees of the O. Hommel Company, Pittsburgh, Pennsylvania received Service Pin Awards from Mr. E. H. Hommel, president of the company, at the twentieth annual presentation ceremony.

Of the large group of present employees, 55% have been working for the O. Hommel Company for over five years, and 13% have over 20 years of service.

During the recent observance, 17 people received their first 5-year service award pins, 18 received their 10-year pins, 3 employees were awarded a 15-year service pin, 5 persons received a 20-year pin and one employee was presented a 30-year service pin award.

• Melvin A. Young has been appointed Administrative Assistant at Laclede-Christy Company Division, H. K. Porter Company, Inc. Mr. Young will work on specific problems in production and engineering.

THE NEW HANDBOOK OF GLASS MANUFACTURE is comprised of more than 500 pages of practical reference data—tables, charts, formulae, illustrations, and text—on all phases of glass manufacture. Each section has its own table of contents, in addition to the master table. A comprehensive index provides quick reference to the contents of the entire book.

Basically, the HANDBOOK OF GLASS MANUFACTURE is intended to give those engaged in glass manufacturing operations a starting point, or point of orientation, with respect to particular problems confronting them. By becoming familiar with materials, apparatus, equipment, and principles relating to a given problem, and with points of view that have proven successful on similar problems in the past, this new Handbook should enable those who use it to get off to a better start in solving a given problem.

It is a primary working tool for plant executives, research heads, laboratory technicians, and engineers. It is complete enough to be used as a text or reference work for a course in glass technology. It can also be used effectively by glass companies as a source of reference to many of their customers and others who wish to obtain a general knowledge of glass manufacturing.

* * *

This new handbook is the product of many individuals, each one particularly qualified to handle the subject assigned to him—a truly collaborative effort. Those who have made this book possible and their subjects appear in the opposite column.

FAY V. TOOLEY, *Editor-in-Chief*

Class Compositions
Aaron K. Lyle, *Hartford-Empire Company, Div. of Emhart Mfg. Company*

Physical Properties of Glass
Donald E. Sharp and A. E. Badger, *Libbey-Owens-Ford Glass Company*

Raw Materials
Samuel R. Scholes, *New York State College of Ceramics, Alfred University*

Procurement of Materials, Supplies and Services
C. L. Rice, *Owens-Illinois Glass Company*

Batch Materials Handling and Preparation
W. Ronald Lester, *Pittsburgh Corning Corporation*

Furnaces and Fuels
Franz G. Schwalbe, *Toledo Engineering Company*

Instrumentation in the Glasshouse
John R. Green, *Minneapolis-Honeywell Regulator Company*

Refractories
W. L. Fabianic, *Owens-Illinois Glass Company*

The Glass Preparation Process
F. V. Tooley, *University of Illinois*; Mellen A. Knight, *Minnesota Mining & Mfg. Company*; Aaron K. Lyle, *Hartford-Empire Company, Div. of Emhart Mfg. Company*; Victor C. Swicker, *Alexander H. Kerr & Co., Inc.*; and Axel Ottoson, *Imperial Glass Corp.*

Feeding and Forming
H. H. Holscher, *Owens-Illinois Glass Company*

Annealing and Tempering
Harold A. McMaster, *Permaglas, Inc.*

Glass Decorating
V. H. Remington, *B. F. Drakenfeld & Co., Inc.*

Auxiliary Information and Tables
F. V. Tooley, *University of Illinois*

FILL IN AND RETURN THE COUPON BELOW TO RESERVE YOUR COPY NOW

GI

The Glass Industry
55 West 42nd Street, New York 36, New York

Date.....

Enclosed please find remittance in the amount of $..... to cover the cost of ..... copies of the HANDBOOK OF GLASS MANUFACTURE. Single copy price, $11.50. Order for 5 or more copies, 10% discount. Add Shipping and Insurance charges, domestic 50¢; foreign 80¢. Foreign remittance in U.S. dollars.

NAME.....

COMPANY.....

STREET..... CITY..... STATE.....

TECHNICAL PAPERS TO BE PRESENTED AT NEW ORLEANS AIME CONVENTION

Six technical papers have been announced for a symposium on alumina source materials in glass, to be held by the Industrial Minerals Division the afternoon of Feb. 25, 1957, at the New Orleans national convention of the American Institute of Mining, Metallurgical, and Petroleum Engineers. They are: "The Use of Alumina in Glass", by E. W. Summers, Owens-Illinois Glass Co., Cleveland; "Flotation Feldspar", by Carroll Rogers, Jr., Feldspar Corp., Spruce Pines, No. Car.; "Dry Processing of Feldspathic Pegmatite", by H. B. DuBois, Golding-Keene Co., Trenton, N. J.; "Nepheline-syenite", by H. R. Deeth, American Nepheline, Ltd., Lakefield, Ont.; "Aplite", by V. V. Kelsey, Dominion Materials Division, Piney River, Va.; "Other Source Materials", by R. W. Hopkins, Calumite Co., Hamilton, O.

Mrs. Pauline Moyd, consulting geologist, of Yonkers, and Frank R. Hunter, of International Minerals & Chemical Corp., Chicago, will be co-chairmen of the session.

L.O.F. PURCHASES LAND

According to a recent announcement L.O.F. Glass Fibers Company has purchased seventy-five acres of land in Corona, California for plant and warehouse site purposes. The new site area is situated on the north side of Corona, a city of some 12,000 population, located 50 miles east of Los Angeles.

R. H. Barnard, president, said that plans for the use of the site are not yet definite but that company engineers are already at work on the first basic steps in planning.

From The Glass Center Of The World

TOMOCO MOULDS

For Bottles, Jars, Pressed Tableware

Tomoco Cast Iron Moulds are designed, engineered and manufactured in a modern plant by skilled craftsmen on the newest and most improved machines. Backed by 38 years of experience, they assure the greatest accuracy and uniformity of product. Trouble-free production at top capacity is yours with Tomoco Moulds.

• • •

PROMPT SERVICE AND DELIVERIES

The Toledo Mould Co.

1923 Clinton St. Toledo 7, Ohio

Phone: CHerry 4-3066

BATTELLE INSTITUTE NAMES NEW DIRECTOR

Dr. Clyde Williams, president of Battelle Memorial Institute, Columbus, Ohio, announced recently that the board of trustees appointed Dr. B. D. Thomas as the institute's new director. In this position, he succeeds Dr. Williams in the management of Battelle's extensive research operations in the United States and Europe.

A member of the institute's executive and technical staff since 1934, Dr. Thomas was appointed assistant director in 1942. Subsequently, he was named secretary of the Battelle Memorial Institute Corporation and in July, 1955, he became vice president.

Dr. Thomas' varied scientific interests are reflected in his report on "The Technology of Iron Ore" for the President's Materials Policy Commission (1951), his published papers on the chemistry of sea water, and his papers on methods of separating, sorting and concentrating of minerals.

Along with his scientific and technical activities, the new 53-year-old director has carried important administrative responsibilities for most of his 22 years at Battelle. He established and headed Battelle's first Division of Chemical Research in 1939, and was a key figure in the establishment of Battelle's research laboratories in Frankfurt, Germany, and Geneva, Switzerland, and in the development of the Institute's recently completed Nuclear Research Center.

COMMERCIAL SELENIUM AGAIN AVAILABLE

B. F. Drakenfeld & Company recently announced that commercial selenium is again available in normal quantities after a shortage which has prevailed since the outbreak of the Korean war.

With selenium again in full supply, ceramic enamels used by the glass and ceramic industries, coloring oxides used in porcelain enamels, and glazes and colors used for various claywares and heavy clay products are once more available without limitations, particularly in the red and orange shade ranges.

DELOS M. PALMER & ASSOCIATES

Consulting Engineers

Mechanical, Electrical & Industrial

•

Designers of
Special Purpose Machinery
For The Glass Industry
Automation

•

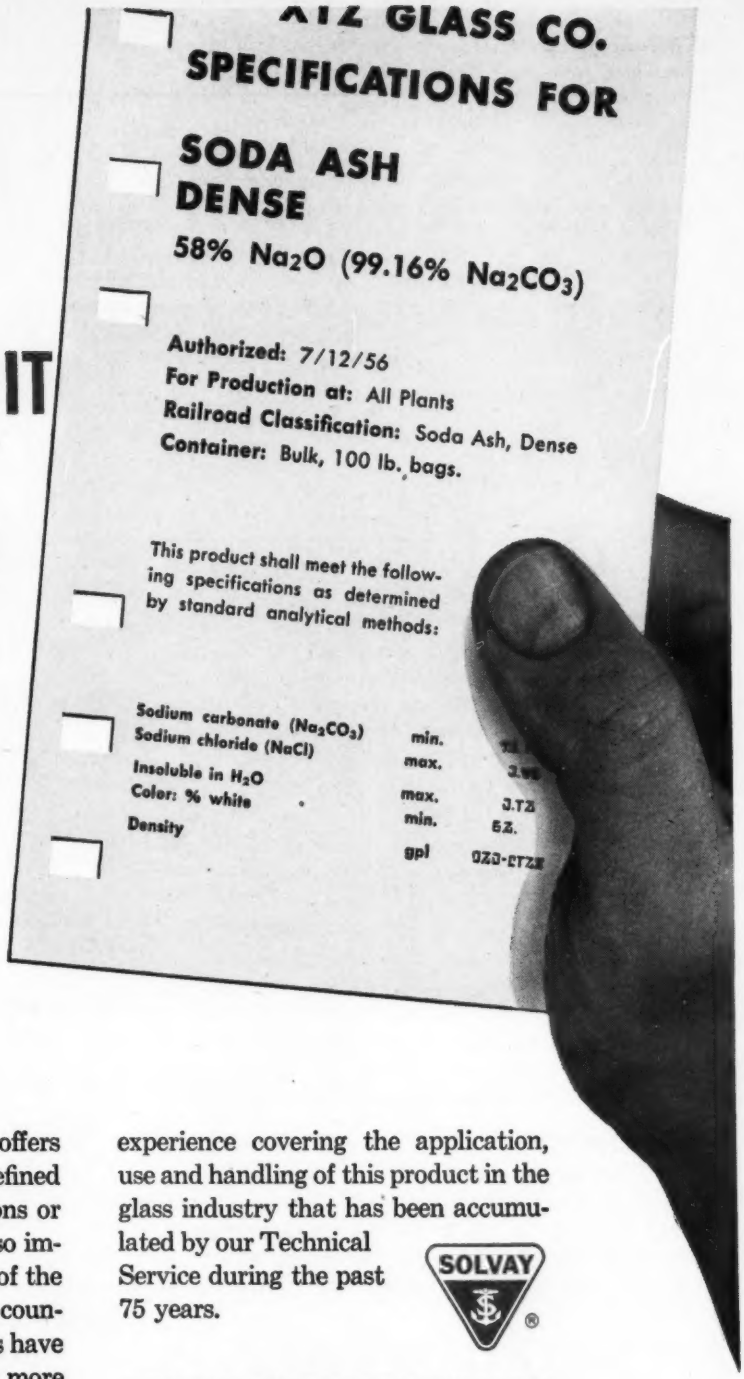
4401 JACKMAN ROAD TOLEDO 12, OHIO

Telephone: Kingswood 9611

YOU WON'T FIND IT IN THE SPECIFICATIONS

...yet it's one of the most important things in buying

SODA ASH FOR GLASS!



The extra services that SOLVAY offers to glass manufacturers are not defined in either the buyer's specifications or in our quotations. Yet they are so important that they represent one of the chief reasons why many of the country's leading glass manufacturers have specified SOLVAY Soda Ash for more than seven decades.

Users of SOLVAY Soda Ash have available to them the vast store of technical and practical knowledge and experience covering the application, use and handling of this product in the glass industry that has been accumulated by our Technical Service during the past 75 years.

SOLVAY®

SOLVAY PROCESS DIVISION

Allied Chemical

ALLIED CHEMICAL & DYE CORPORATION
61 Broadway, New York 6, N. Y.

BRANCH SALES OFFICES:

Boston • Charlotte • Chicago • Cincinnati • Cleveland • Detroit • Houston
New Orleans • New York • Philadelphia • Pittsburgh • St. Louis • Syracuse

SOLVAY CHEMICALS FOR GLASSMAKING

Soda Ash • Potassium Carbonate • Ammonium Bicarbonate • Sodium Nitrite

Soda Ash • Caustic Soda • Calcium Chloride • Chlorine • Potassium Carbonate • Sodium Bicarbonate • Ammonium Bicarbonate
Cleaning Compounds • Ammonium Chloride • Caustic Potash • Sodium Nitrite • Snowflake® Crystals • Para-dichlorobenzene
Ortho-dichlorobenzene • Monochlorobenzene • Chloroform • Methylene Chloride • Carbon Tetrachloride • Hydrogen Peroxide
Methyl Chloride • Aluminum Chloride • Vinyl Chloride

Serial No.	Method of silvering	Time allowed for silvering	Thickness in mm. ($X10^{-6}$) by titration	by direct weighing	by Iodine crystal
1	Dipping	5 minutes	98.9	105.6	92.0
2	"	10 "	115.4	122.3	123.0
3	"	20 "	131.8	139.2	123.0
4	"	40 "	148.1	155.4	154.0
5	Pouring	10 "	274.0	285.9	could not be determined, as the central portion of the concentric colored ring system was not transparent, after the exposure to Iodine, even for 24 hours.
6	"	20 "	479.4	507.8	
7	"	40 "	643.9	682.4	
8	"	60 "	690.5	724.5	

jected to the same method of cleaning. Silvering was done with equal volumes of silvering and reducing solutions, prepared in the following manner:

Silvering solution: To silver nitrate solution (1 g. dissolved in 8 ml. of distilled water) ammonia (1.34 N) was added very slowly until the precipitate first formed nearly redissolved, it was then filtered and the solution was made up to 100 ml.

Reducing solution: 0.2 g. silver nitrate was dissolved in 100 ml. of boiling distilled water, 0.5 g. of Rochelle salt was added and the solution was kept boiling for half an hour. The solution was filtered hot, cooled and made up to 100 ml. and kept in an amber colored bottle.

Solutions of the same strength were used in all cases for the deposition of silver films. To develop varying thickness of silver films, both dipping and pouring methods were used with varying time intervals.

The results are tabulated in the table below showing comparison between different methods for the determination of the thickness of silver films. (Temperature 30°C.)

DISCUSSION

The direct weighing method showed somewhat higher values than those obtained by titration or by Fizeau's method. This may be due to the difficult elimination of moisture from the silver film and to the oxidation of the silver film during drying. The time required to find out the thickness of the silver film by direct weighing method was more than that required for the other two methods.

When the thickness of the silver film was more than 200 x 10^{-6}mm, the spot produced by the iodine vapor on the silver film was not transparent but more or less opaque, also the rings produced were so distorted that they could not be counted properly. But when the film is thin, the iodine vapor method can give a fair and quick idea of the thickness of the silver deposit. But it is not dependable for the accuracy of the result.

The titrimetric estimation of silver film is the quickest and the method for determining the amount of silver is well known for its accuracy.

REFERENCES

(1) J.B.—"Methods of Control in Glass Silvering Practice". *Glaces & Verres 1937*, 52, 13-16. Abs. Amer. Cer. Soc. 1938, pg. 64.

(2) Liepus, T.—"The Behaviour of Silvered Glass Surface on Heating". *Glas. Tech. Ber 1935*, 13, 270-278.

(3) Nifontova, E. S. & Pototskaya, G. V.—"The Minimum Consumption in Mirror Manufacture". *Steklo i. Keramika 1948* (8), 8-10. *Abs. Jrnl. Soc. Glass Tech. 1949*, pg. 145.

(4) Gardner, I. C. & Case, F. A.—"The Making of Mirrors by the Deposition of Metals on Glass". *Circular of the Bureau of Standards No. 389*, U.S.A.

(5) Fizeau—*Annales de chimie et de Physique 1861*, 63, 385.

(6) Sen, P. & Rao, P. S.—"Silvering on Glass". *Jrnl. of Ind. Chem. Soc. Ind. & News Ed.*, vol. 14, no. 3 & 4, 1951.

THE SHARP-SCHURTZ COMPANY

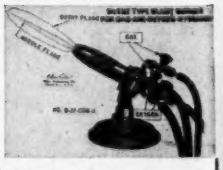
CHEMISTS AND CONSULTING ENGINEERS FOR THE GLASS INDUSTRY

LANCASTER, OHIO U. S. A.

EISLER Equipment
solves glass problems!

Since 1920, designers and builders of special machinery and equipment for the glass industry . . .
Glass Lathes • Glass Cutters • Wet or Dry Silent Blast Torches • Cross Fires • Ribbon Fires • Gas and Oxygen Burners • Indexing Turntables • Sealing, Ampule and Bulb Blowing Machines, etc.
Call us now without obligation

Above: SPECIAL CROSSFIRES
Below: BLAST BURNERS

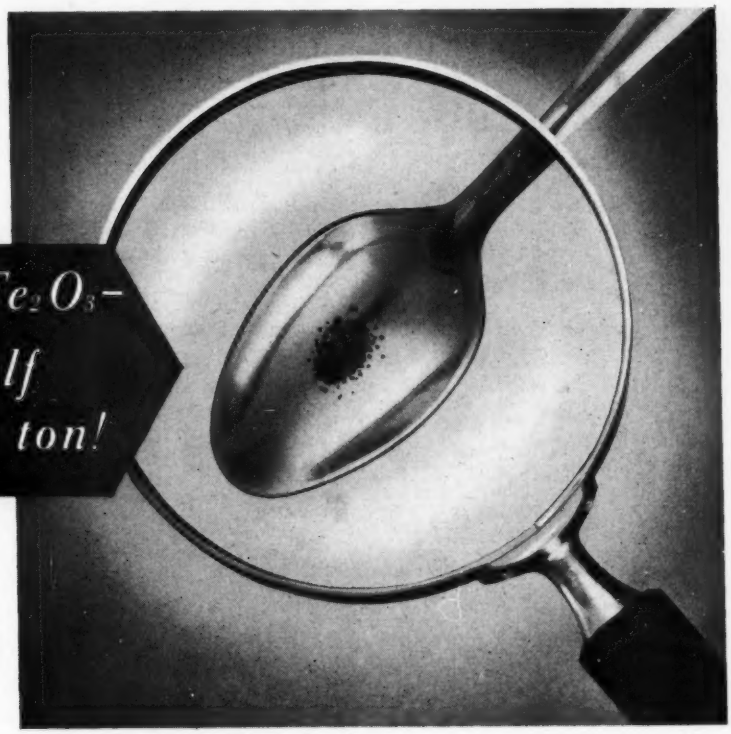


EISLER ENGINEERING CO., INC.
742 So. 13TH ST., NEWARK 3, N. J.

Charles Eisler, Jr.
President

Westvaco®

SODA ASH... *better because*



only this much Fe_2O_3– Less than one-half of an ounce in a ton!

Chemical usage-WESTVACO Soda Ash produces clear, colorless solutions. There's never any iron discoloration in finished products.

Other impurities are at the minimum, too. WESTVACO Soda Ash is absolutely free of corrosive ammonia, contains only a trace of salt, sulfate and calcium. Boron content less than 8 ppm., heavy metals 3 ppm. Exceptional purity gives you more Na_2CO_3 for your money! Write your nearest WESTVACO office for quotation.

Westvaco CHEMICALS

fmc FOOD MACHINERY AND CHEMICAL CORPORATION

Westvaco Chlor-Alkali Division
FOOD MACHINERY AND CHEMICAL CORPORATION
161 E. 42nd St., New York 17 · Chicago St. Louis Denver Philadelphia So. Charleston, W. Va.

FMC CHEMICALS INCLUDE: BECCO *Peroxygen Chemicals* • WESTVACO *Alkalis, Chlorinated Chemicals and Carbon Bisulfide* • NIAGARA *Insecticides, Fungicides and Industrial Sulphur* • OHIO-APEX *Plasticizers and Chemicals* FAIRFIELD *Peroxide, Compounds and Organic Chemicals* • WESTVACO *Phosphates, Barium and Magnesium Chemicals*

BABCOCK & WILCOX APPOINTS R. K. ALLEN

Robert K. Allen has been appointed superintendent of product development at the Alliance, Ohio Research Center of The Babcock & Wilcox Company, it was announced by Paul R. Grossman, director of the Research Center, and George W. Kessler, chief engineer, Boiler Division. Mr. Allen succeeds the late G. A. Watts.

Mr. Allen joined B&W in 1936 as a student engineer in New York following his graduation from the University of Colorado School of Mechanical Engineering. After serving in Boiler Division engineering capacities both in New York and Pittsburgh, he was made supervising engineer in New York in 1951 and assistant chief staff engineer in 1955.

GLASS CONTAINER INDUSTRY CITED FOR ANTI-LITTER LEADERSHIP

Smith L. Rairdon, vice president, Owens-Illinois, and Henry W. Kuni, secretary-treasurer, Glass Container Manufacturers Institute, were among those who received special citations at the close of 1956 from Donald J. Hardenbrook, president of Keep America Beautiful, Inc., for outstanding services in the war on litterbugs.

Medallions bearing the official Keep America Beautiful symbol were presented to Mr. Rairdon and Mr. Kuni "in recognition and appreciation of their leadership through the early developmental stages of the nationwide educational program to stimulate individual responsibility and pride in clean, safe and attractive surroundings."

Commending the glass industry for its pioneer role in the KAB movement, Mr. Hardenbrook said: "The companies cooperating in this program are putting free enterprise to work for the benefit of everyone. Glass container manufacturers, together with other basic industries are concerned about the litter potentials that are inevitably linked with our expanding economy and our increasing use of outdoor recreational facilities. They are in the vanguard of one of the most important public service campaigns ever launched. We rely on accelerated participation, in the future, by these and other business leaders for the achievement of our common goal."

Founded in December, 1953, Keep America Beautiful, Inc. is supported by a group of the nation's most influential business firms, national trade associations and labor unions, representing some 50 major industrial categories, together with over 40 national civic and public interest organizations and four federal government departments, all pooling their educational resources in one vast, coordinated effort to preserve and improve America's scenic beauty. Mr. Rairdon is board chairman and immediate past president of KAB, Inc. Mr. Kuni is treasurer of the organization.

Introducing ANOTHER TECO DESIGNED

SPECIAL PURPOSE DECORATING LEHR

A TECO gas fired, ball bearing, "Firoll" lehr. For high production with remarkable fuel economy.

TECO "Firoll" lehrs receive their name from the "Firoll" principle of heating, developed by Toledo Engineering Company, to provide an efficient, low maintenance, controllable supply of uniform heat to the ware to be processed.

We design and build all types of glass annealing, decorating and bending lehrs, using either gas or liquid fuel.

100 watt Verd-A-Ray bulbs coming from special lehr where Verdex glass-on-glass finish is fired on the bulb under intense controlled heat at the rate of 200,000 per day.
VERD-A-RAY CORP.
TOLEDO 5, OHIO

TOLEDO ENGINEERING Company

PHONE-KLONDIKE 1529

DESIGNERS AND BUILDERS OF GLASS MELTING FURNACES
3001 SYLVANIA AVENUE, TOLEDO 13, OHIO

Illustrated Lehr has 72 inch wide wire mesh belt and is 60 feet long.

Inventions and Inventors . . .
(*Continued from page 94*)

melting tank a glass batch including the following ingredients in substantially the proportions indicated:

Sand	1000
Burnt dolomitic limestone	116
Burnt calcium limestone	50
Soda ash	286
Salt cake	44
Aplite	55
Carbon	1.32
Rouge	6.28
Cobalt oxide	.0114
Cullet	800

It will be noted from the above batch that an unusually large amount of iron is employed as compared to the negligible amount usually considered to be permissible in automotive glass.

It has been found that a glass can be produced with a ratio of ferric to ferrous iron that will result in the absorption of both light and heat rays that are undesirable for comfortable vision, without seriously affecting the desired visibility through the glass.

There is included in the batch for the glass of this invention sufficient carbon, or other reducing agent, to reduce enough of the ferric oxide to ferrous oxide to obtain the desired balance between the two.

In order to supplement and control the coloring action of the ferrous and ferric oxide, and to make possible variations in the proportion of ferrous oxide to ferric oxide that are necessary to produce the desired balance between the two without affecting the wanted color, cobalt (preferably in the form of cobalt oxide) is also added, in very small amounts as indicated above, to the batch. The cobalt oxide does not affect the state of oxidation of the iron in the glass, and effectively masks the slight shade variations which may occur in the commercial production of glass with a definite aimed-at ratio of ferric to ferrous oxide.

There were 3 claims and the following references cited in this patent: 1,936,231, Gelstharp, Nov. 21, 1933; 2,034,994, Sharp et al., Mar. 24, 1936; 2,223,118, Miller, Nov. 26, 1940; 2,244,468, Lytle, June 3, 1941; 2,524,719, Tillyer, Oct. 3, 1950; 2,581,639, Duncan, Jan. 8, 1952; 2,636,420, Ryan et al., Apr. 28, 1953, and 550,782, Germany, 1932.

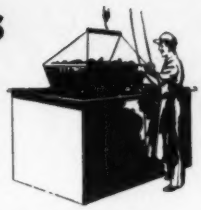
G. J. GRAHAM APPOINTED VICE PRESIDENT THATCHER GLASS MANUFACTURING COMPANY, INC.

Franklin B. Pollock, chairman of the board of Thatcher Glass Manufacturing Company, Elmira, New York, announced the appointment of Gerald J. Graham as vice president. He will be located at the company's Chicago offices, 35 East Wacker Drive.

Mr. Graham has been associated with the Glass Industry for about 37 years, and was formerly president of the Graham Glass Company, which has been acquired by Thatcher.

• George Dusterdieck has been named branch manager of Thatcher Glass Manufacturing Company's Rochester sales office, with headquarters in the Sibley Tower Building. Mr. Dusterdieck succeeds G. W. Peck.

Clean glass molds without scraping or sandblasting!



Now, simply by soaking and rinsing, you can quickly remove heat scale, mold lubricants and carbon from steel molds used in producing bottles, jars, jugs and other items. Oakite specialized compounds do the job chemically. They work fast because of their outstanding ability to wet-out, dissolve and break up soils . . . emulsify oil, grease . . . rinse freely.

Talk to your local Oakite Technical Service Representative, or write for details to Oakite Products, Inc., 25C Rector Street, New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS · METHODS · SERVICE
SCIENCE

Export Division Cable Address: Oakite

Technical Service Representatives in Principal Cities of U. S. and Canada

Now the industry's most popular Cerium Oxide

CEROX

is Suspension-Treated

by the ROBINSON-HOUCHIN method

★★ If suspension is a problem in your polishing machines, ask your supplier for suspension-treated CEROX ST.

★★ Prompt shipments in any quantities at the same price as regular CEROX.

TO COLOR AND DECOLORIZE GLASS – Cerium, Didymium (cerium-free) Salts, Neodymium and other Rare Earths – **A GRAM OR A CARLOAD**

LINDSAY CHEMICAL COMPANY

254 ANN STREET, WEST CHICAGO